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REVISED REMEDIAL ACTION FINAL (100 PERCENT) DESIGN REPORT

VOLUME I OF III

DESIGN REPORT
TECHNICAL SPECIFICATIONS

ENVIRO-CHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

Prepared for:
ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION SITE TRUST FUND

Radian Project Number 002455.06

June 1997

RADIAN
INTERNATIONAL LLC

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Prepared for:
Environmental Conservation and
Chemical Corporation Site Trust Fund

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September, 1996

(Includes Final Design Revisions
through June 12, 1997)

RADIAN INTERNATIONAL LLC

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1.0 Introduction

1.1 Introduction

This Final (100 Percent) Design Report has been prepared for the Revised Remedial Action (RRA) for the Environmental Conservation and Chemical Corporation Superfund Site (Enviro-Chem Site or Site) located in Boone County, Indiana. This Final Design addresses U.S. EPA and IDEM comments on the 90 Percent Design, submitted to U.S. EPA in October, 1995. The Final Design as approved by U.S. EPA and IDEM will be the construction document. The Enviro-Chem Site as described includes the area within the remedial boundary and the surrounding support zone area which is presently enclosed by a security fence.

The RRA consists of the following major components:

1. Wastewater storage, handling, and treatment during construction and operation of the RRA.

2. Excavation of the southern concrete pad and subbase soils to a depth of nine feet (approximately 10,500 CY).

3. Placement of the excavated materials in a fill on the northern part of the Enviro-Chem Site, within the remedial boundary, for treatment by vapor extraction.

4. Backfill of the excavation with native soils and possibly, placement of a RCRA compliant cover depending on the results of excavation soil sampling.

5. Placement of a temporary (Stage 1) clay soil cover over the northern part of the Enviro-Chem Site, within the remedial boundary.

6. Vapor extraction of the covered in-situ soils and fill materials in the northern area of the site. (Estimated to be a two-year operation).

7. Placement of a Stage 2 final cover over the northern Site area upon verification of soil cleanup.

The RRA will also include site preparation activities prior to construction, including construction of wastewater storage and transfer and treatment systems, stormwater drainage channels, and erosion control measures. The RRA will include the operation of the vapor extraction system, the wastewater handling, storage and treatment system, and performance of soil cleanup verification sampling.

The original remedial action included in the original Exhibit A of the Consent Decree consisted of in-situ soil vapor extraction (SVE), a Resource Conservation and Recovery Act (RCRA)-compliant Subtitle C cover (RCRA compliant cover), access restrictions, and subsurface and surface water monitoring. The Consent Decree was signed by the U.S. EPA, the State of Indiana, and a group of Potentially Responsible Parties (PRPs), and was entered in the U.S. District Court for the Southern District of Indiana on September 10, 1991.

Exhibit A and the Consent Decree were revised to reflect additional data obtained from supplemental site investigations and several engineering and operational modifications to the remedial action.

Revisions to the original remedial action described in the original Exhibit A have been made, with U.S. EPA's approval in part because saturated conditions beneath the southern concrete pad would interfere with the implementation of in-situ SVE in that area. The site conditions were better defined as a result of a number of reports, including the November 1994 Southern Concrete Pad Area Investigation Report. The 1994 investigation report provided new data that indicates the presence of sand deposits in the lower portion of the proposed zone of SVE treatment, in the eastern area of the concrete pad. This sand deposit may be hydraulically connected to the sand waterbearing zone beneath the till. The investigation also confirmed that the potentiometric surface of the sand waterbearing zone is 4 to 6 feet below ground surface in the southern area of the site.

The remedy presented in the original Exhibit A has been modified to address the concrete slab and soils from the southern concrete pad area by including the excavation and spreading of these materials onto the northern portion of the site for treatment by SVE rather than in-situ SVE of the area. The excavation created will be backfilled with native soils. The SVE system is designed at this stage by performance specifications rather than specifying the injection/ extraction trench method only. Additionally, modifications have been made, to the final cover design. The revised Exhibit A and Consent Decree were approved by U.S. EPA in August, 1996.

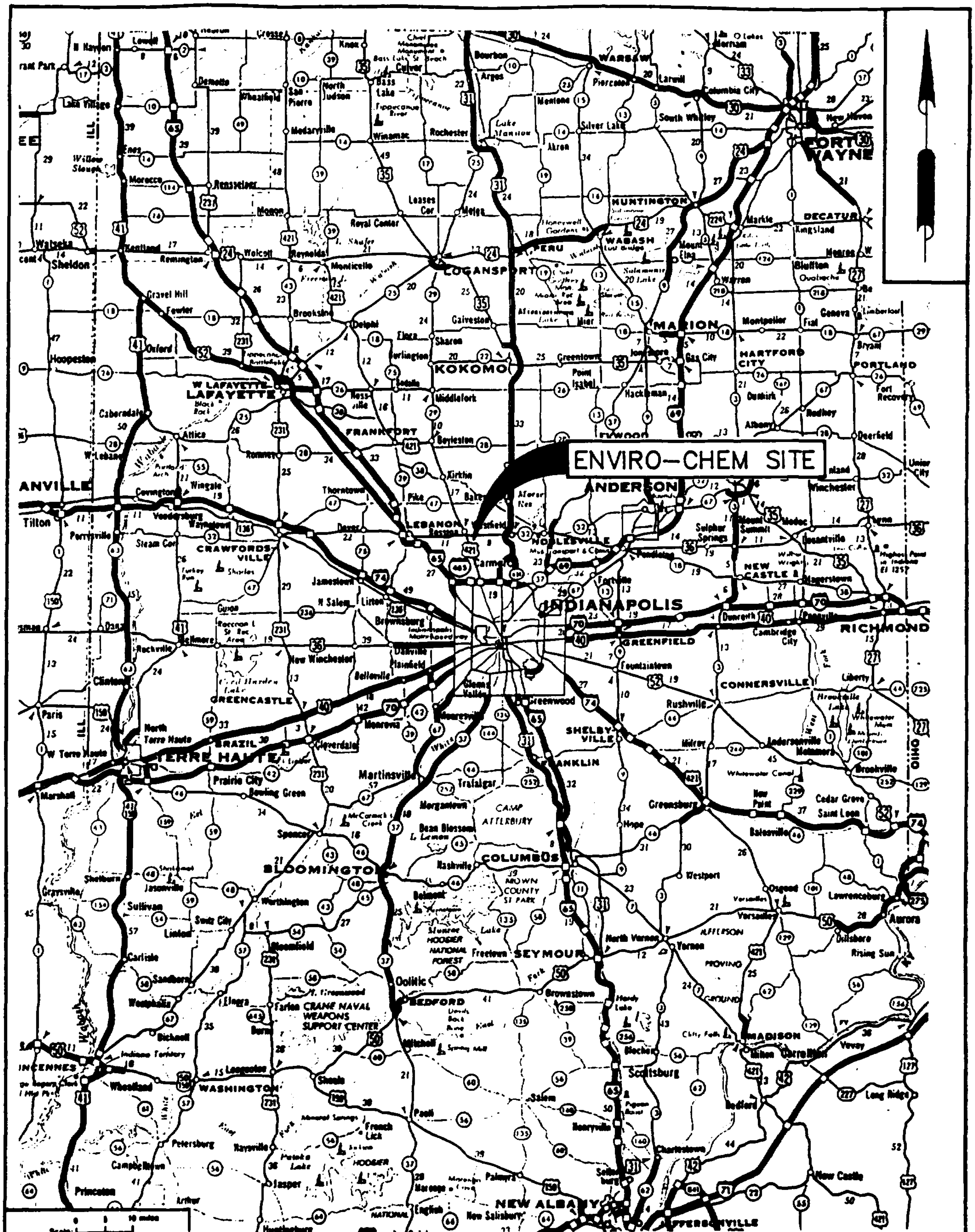
The Soil Vapor Extraction (SVE) system has been designed using a performance-based technical specification. The technical specification outlines minimum criteria for construction, start-up, operation, and monitoring of the SVE. It is currently contemplated that the Remedial Contractor will be selected by the Enviro-Chem Trustees based on, among other things, it's submitted bid and proposed SVE approach to the performance specification. The Remedial Contractor will be required to prepare a Final Design for the SVE system after U.S. EPA conceptual level concurrence of the proposed SVE methodology. The Contractor SVE Final Design will include specifications, design drawings, and an Operations and Maintenance Manual for the SVE system. The Contractor Final Design for the SVE system will be submitted to U.S. EPA for final approval prior to proceeding with construction (hereafter referred to as the SVE "second look").

1.2 Site Description

The Enviro-Chem Site is located in Boone County, approximately 10 miles northwest of Indianapolis, on U.S. Highway 421 in Zionsville, Indiana (Figure 1-1). The site lies to the west of the Northside Sanitary Landfill (NSL), a closed solid waste disposal facility which is also a Superfund Site. The Enviro-Chem Site is bounded on the south, east, and north by property owned by members of the Bankert family, and on the west by a Bankert-controlled corporation, Boone County Resource Recovery Systems, Inc. (BCRRS). An unnamed ditch separates the Enviro-Chem and NSL Sites along the Enviro-Chem Site's eastern boundary. A number of residential homes are located within ½ mile of the facility to the north and west.

1.3 Site History

In 1977, Enviro-Chem began operations at the site which consisted of the recovery, reclamation, and brokering of primary solvents, oils, and other wastes. Waste products were received in drums and bulk tankers and prepared for subsequent reclamation or disposal. The processes that were used to reclaim solvents and oil included distillation, evaporation, and fractionation.



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SITE LOCATION MAP			
ENVIRO-CHEM SUPERFUND SITE		ZIONSVILLE, IN	
CLIENT: ENVIRONMENTAL CONSERVATION & CHEMICAL CORP. TRUST		JOB NUMBER: 2455	
SCALE: AS SHOWN	FIGURE NUMBER	1-1	REV 0

Investigations concerning the accumulation of contaminated stormwater on-site, drum inventory, and several spill incidents led to a civil law suit filed by the Indiana State Board of Health, and finally the placement of Enviro-Chem into a state-court receivership in July 1981.

Drum shipments to the site were halted in February 1982. Surface removal activities conducted during 1983 and 1984 under a Consent Decree entered in 1983 included the removal of cooling pond waters and sludge, waste drums, tank wastes, and contaminated soil.

A Remedial Investigation/Feasibility Study (RI/FS) was conducted by CH2M Hill of Milwaukee, Wisconsin, for the U.S. EPA from 1983 through 1986. The Record of Decision (ROD) for the site was published on September 25, 1987 and amended on June 7, 1991, and the Consent Decree for the remediation of the site was entered on September 10, 1991.

On September 30, 1992, the U.S. EPA and the Enviro-Chem Trustees agreed to separate the remedial construction activities into two distinct phases. The activities in each phase are those related to: (1) site clearing and grading, the establishment of the support zone and drainage ditches (i.e., the Site Preparation and Material Removal (SPMR) activities); and (2) the implementation of the SVE and the installation of the site cover and monitoring. The SPMR activities were completed on November 30, 1993 and the Construction Completion report (including the as-built drawings) was submitted on March 4, 1994.

To investigate the water conditions at the site, AWD (formerly DEI and now Radian International, LLC) conducted Phase I and II Supplemental Investigations in September 1992 and January 1993, respectively. A concrete pad area subsurface investigation was conducted by AWD in November 1994, to provide additional data for evaluation of excavations in the pad area. A summary of the results of the hydrogeologic data generated from these investigations is presented in the Specifications.

A Preliminary Design (30 percent) was submitted to U.S. EPA in January, 1995. Responses to U.S. EPA and IDEM comments on the design were submitted to U.S. EPA in May, 1995. These responses were incorporated in the original Pre-Final (90 percent) Design submitted to U.S. EPA in October, 1995.

A Central Support Zone Investigation (CSZI) was conducted by DEI (now Radian International, LLC) in July, 1995 to determine the presence of VOCs in soils located in the central support zone area to the west of the Site Remedial Boundary. The findings of the investigation resulted in an extension of the remedial boundary westerly approximately 100 feet into the central support zone to encompass the area bounded by Line "D". This modification is incorporated into the Final Design.

U.S. EPA comments on the original 90 Percent Design were provided on July 3, 1996. These comments have been addressed in the Final Design submitted on September 25, 1996. Subsequent U.S. EPA and IDEM comments were received on _______________, 1996 and January 17, 1997. Only revised pages and drawings were prepared in response to those comments and these have been incorporated into this Final Design.

2.0 Revised Remedial Action Design

2.1 Summary of the Revised Remedial Action (RRA)

Soil vapor extraction (SVE) will be employed over the northern and central areas within the remedial boundary. The southern area of the site which includes a concrete pad, aggregate subbase, and subsurface soils will be excavated to a depth of approximately nine feet and placed on the northern portion of the site for SVE treatment. The concrete pad will be crushed into pieces with a maximum dimension of 3 inches prior to placement on the northern portion of the site. A low permeability barrier will then be installed between the central and southern areas of the site to minimize migration of subsurface water and/or vapor from the central area to the southern area. The excavation at the southern area of the site will then be backfilled with native soils.

A difference in approach between the original remedial design and the RRA is that the concrete pad and a portion of the on-site soils from the southern concrete pad area will be excavated and placed on the northern area of the site for SVE treatment. The northern and central site areas will be capped with a RCRA-compliant cover. The southern concrete pad area soils will be remediated by performing the following activities:

- Pressure grout the existing 20-foot by 20-foot by 12 feet deep sump (i.e., the ECC sump) located in the concrete pad area. The grouted interval will be from the floor of the excavation to the bottom of the sump;

- Crush the concrete pad into pieces with a maximum dimension of 3 inches, and place the crushed concrete along with the aggregate subbase in a segregated treatment zone in the northern end of the site. The concrete pads and subbase aggregate at the former process building and at the former entrance road to the facility shall also be removed, crushed, and combined with the crushed southern concrete pad for SVE treatment;

- Water collected in the sump and the excavation shall be pumped to temporary storage facilities and will be treated on-site and discharged on-site to surface water (via on-site diversion channels) in accordance with applicable Federal, state, and local regulations. Off-site disposal will be used if the discharge limits are not achieved and on-site storage capacity is exceeded;

- Excavate the subsoils;

- Perform exit soil sampling in the excavation (by U.S. EPA);
- Install a low permeability barrier between the excavation and the SVE treatment area;
- Backfill the excavated area with native soils; and
- Place a 12-inch layer of topsoil on the backfill soils in the excavated area and seed with appropriate vegetation. The potential need for a RCRA-compliant cover or covers in this area will be based on the results of any exit soil sampling in the excavation.

A second difference in the RRA from the original Exhibit A is that the SVE system design is performance-based. It may but need not consist of trenches or other SVE techniques such as wells. If the Contractor proposes a technique other than trenches, an explanation shall be provided by the bidder as to why a particular technique is proposed. The sequence of activities leading to the submittal of the SVE System Final Design to the U.S. EPA and the Indiana Department of Environmental Management (IDEM) will include:

- Solicitation of qualifications for remedial construction and development of a pre-qualified short list for bidding;
- Preparation of the RRA Final (100%) Design, including SVE performance specifications, based on U.S. EPA/IDEM comments on the 90% Design;
- Procurement of remedial contractor bids;
- Receipt and evaluation of bids, including the SVE design concepts that each bidder proposes to use to meet the performance-based requirements for the SVE system and conceptual level concurrence from U.S. EPA and IDEM regarding contractor approaches for SVE system design;
- Selection of a successful bidder;
- Preparation of a detailed SVE System Final Design by the Contractor;

- Submittal of SVE System Final Design plans and specifications to U.S. EPA and IDEM for approval ("second look"); and

- Receipt of comments and subsequent approval of the revised SVE Final Design plans and specifications.

2.2 Design Components

As indicated in Section 2.1, the SVE Final Design (second look) may vary depending on the design proposed by the Remedial Contractor selected to perform the SVE treatment. The following sections describe the Final Design (100%) of the RRA to be performed by the Contractor, including the SVE performance requirements. Design details are contained in the appended specifications, project plans, and drawings.

2.2.1 Site Preparation and Environmental Controls

The initial site activities undertaken for the RRA will be site preparation and environmental control. These include the following:

- Setup of Remedial Contractor Support Zone;

- Installation of erosion and sedimentation control measures; and

- Installation of water storage, handling and treatment systems.

These activities will be implemented prior to any excavation of the southern concrete pad area (see Section 2.2.2).

2.2.1.1 Support Zone

The Remedial Contractor shall mobilize the required personnel, equipment, and materials on-site and establish an on-site Support Zone for clean operations. The Support Zone is described in the Construction Health and Safety/Contingency Plan and is shown on the Drawings.

The Support Zone will contain temporary site facilities, including office trailers, utility hookups, wastewater Storage, handling and treatment systems, equipment and personnel decontamination facilities, and equipment laydown areas. The Support Zone shall be within the existing new security fence and outside of the remedial boundary area.

The existing decontamination and wastewater storage pads shall be used for the RRA construction. The pads will be inspected, repaired, if necessary, and put into service prior to any construction activities within the Remedial Boundary.

The Support Zone will also contain the weather-protected SVE mechanical equipment, vapor treatment system, and control systems. The exact location of these facilities will be proposed by the selected Remedial Contractor.

2.2.1.2 Erosion and Sedimentation Control Measures

Soil erosion and sedimentation measures shall be undertaken initially for the following components of work:

- Access and temporary haul roads;
- Stormwater drainage channels; and
- Borrow area.

Access and Temporary Haul Roads

Access roads to the support zone and equipment laydown area have been covered with an aggregate paving layer as shown on the Drawings. Silt fences shall be placed between the access roads and adjacent stormwater drainage channels to contain any sediment transported from the roads during stormwater runoff events.

Temporary haul roads from the site to the on-site borrow area (if used) will follow the route of existing access roads where possible. Silt fence shall be placed adjacent to the temporary haul roads as necessary to prevent sediment transport into existing surface water channels. Dust generated from traffic on access roads or temporary haul roads will be controlled.

Sediments trapped behind silt fences will be excavated after completion of construction and spread along the access/haul road shoulders in areas that are not subject to erosion. The sediment fill will be vegetated. Particulate monitoring will be performed on-site during construction, in addition to visual assessments, to determine the need for dust control. Typical dust control methods include:

- Water application; and
- Modifications to hauling routes and scheduling

Stormwater Drainage Channels

Stormwater runon and runoff in the Support Zone shall be managed by diversion channels adjacent to the support zone and Parcel 45 and the existing north and south diversion ditches which drain into the unnamed ditch. Diversion channels and the north and south ditch improvements have been installed during previous site preparation activities. The channels have been constructed in a temporary condition in some sections that have encountered construction debris and miscellaneous fill. These channels shall be upgraded and some shall be relocated to conform with the final cap configuration (see Appendix A calculations). All stormwater drainage channels have been designed based on a 25-year storm frequency.

The upgraded diversion channels and ditches shall be lined with either a vegetative cover or concrete revetment mat to minimize erosion. The diversion channels and ditches to be revegetated will have erosion control berms placed along the channel sections immediately after placing the channel linings. The erosion control berms will consist of staked, double-straw bales placed across the channel bottom, perpendicular to the direction of flow. The erosion control berms will be placed at a spacing of 100 feet within each new or improved channel section.

Borrow Area

The on-site soil borrow area near the NSL Superfund Site shall be used as a source of on-site backfill and cover material if sufficient volume of material is available. The ECC Trust under a 1993 agreement with the Bankert's has a right to use up to 40,000 cubic yards of soil from the NSL borrow area to the extent available. Currently the borrow area is being excavated as part of the NSL site closure. Excavation is expected to be completed in the spring of 1997, at which time the Contractor may evaluate the borrow area and determine its suitability. Based on available data, these soils have been suitable to meet the RCRA-compliant cover specifications for the Enviro-Chem Site, however, the available data may not be adequate to evaluate the soil remaining after NSL operations are completed. The Contractor shall use this material to the extent available unless an optional borrow source is identified.

The Contractor may use alternate borrow sources to the extent necessary to complete the RCRA-compliant cover, excavation backfill, and other soil fill requirements. The alternate borrow area shall be used only if the material meets applicable specifications and is approved by the Enviro-Chem Trustee's Engineer. Erosion and sedimentation controls will be provided in the borrow area and the borrow area haul roads leading to the site, as necessary.

2.2.2 Southern Concrete Pad Remedial Activities

The southern concrete pad includes the concrete slab (approximately 30,000 square feet), the ECC sump, subbase aggregate, and subsoils.

The objective of the southern concrete pad remedial activity is to remove contaminated concrete, subbase, and soil from the Concrete Pad Area, and to spread the excavated material over the northern portion of the site to be vapor extracted. The concrete will be crushed to a maximum particle size of 3 inches, and will be placed along with the crushed concrete from the former building slabs in the northern area and the concrete subbase in a segregated layer.

The soil in the Concrete Pad Area will be excavated to a depth of 9 feet (or further as described below), as measured from the top of the concrete pad. This removal and backfill with native soils ensures a level of cleanup in the southern portion of the site greater than or equal to the originally proposed SVE for the Concrete Pad Area. The eastern portion of the concrete Pad Area may require sheet-piling to control infiltration from the underlying sand water-bearing zone. All water collected in the excavation will be treated and discharged on-site in accordance with the substantive requirements of applicable federal and state laws unless during the excavation the water treatment system is shut down and water accumulates in the water collection system in excess of storage capacity, then additional waters generated during the excavation will be disposed of off-site in accordance with all requirements of federal and state laws and regulations.

2.2.2.1 Sump Installed by U.S. EPA (ECC Sump)

The ECC sump is located at the southeastern corner of the concrete pad. The ECC sump is understood to be a 20-foot square, 12-foot deep pit that has been backfilled with gravel-sized aggregate. The sump may be interconnected with the sand waterbearing zone. In order to provide a low permeability layer below the depth of the excavation, the lower portions of the ECC sump will be sealed by using pressure-injection grouting. The sump will be grouted prior to excavating the concrete pad and subsoils.

The upper portion of the sump will not be grouted closed because it will be used to dewater the excavation, and will later be removed during the excavation of the subsoils. Design criteria for the injection grouting include the following items:

- Grouting will be in the interval from the base of the shallow till (silty clay zone) to a depth of 9 feet below the top of the concrete pad. This interval is expected to be 3- to 5-feet thick based on available site data;
- A cement-based grout will be used;
- The number of injection borings and their spacing will be designed to completely fill all voids in the sump;
- Well No. ECC MW-12, located within the sump, shall be abandoned as part of the grouting sequence. The well shall be drilled out and regrouted beneath the proposed excavation bottom.
- Grouting should begin from the perimeter of the sump and move to the center; and
- The maximum injection pressure should be limited by the pressure that the overburden soil can support to avoid uplift and fissuring and the movement of the grout into the upper areas of the sump.

The depth of the sump and its approximate horizontal limits will be confirmed by test borings drilled during the initial stages of construction.

2.2.2.2 Concrete Pad and Subbase Removal and Handling

The southern concrete pad will be crushed on-site into pieces with a maximum dimension of three inches. Crushing and crushed material handling operations will be conducted within the remedial boundary. The southern pad is expected to be four-inches thick and be non-reinforced. Bulk volume is estimated at 350 cubic yards, or approximately 700 tons. The concrete pad will be broken in place by hydraulic hammer equipment and the broken sections (12 inches or less) shall be dumped directly into the feed hopper of a portable impact or jaw crusher. A discharge conveyor shall deposit the crushed material directly into haul trucks or into a pile for subsequent placement in the segregated fill zone. The crusher shall be operated within the central or northern site area. Nominal capacity of the crusher shall be 50 tons per hour.

Air monitoring will be performed during crusher operations to measure potential particulate and VOC vapor emissions. Air monitoring measures are described in Section 2.2.2.8.

Subbase aggregate is expected to be 18 inches of coarse gravel-sized material. Approximately 1,500 cubic yards of aggregate is estimated in the southern concrete pad area. This material will be directly excavated once the concrete pad is removed. Some subbase dewatering may be necessary prior to excavation (see Section 2.2.2.5).

Crushed concrete and excavated subbase aggregate shall be placed together in a fill zone on the northern edge of the fill area. This fill zone has a capacity of 2,000 cubic yards, including allowances for crushed concrete and aggregate from other site areas (see Section 2.2.3) and it will be segregated from the subbase soil fill areas for purposes of SVE treatment. The coarse materials shall be placed in maximum 12-inch thick lifts which shall be compacted by vibratory equipment. Finished grade of the crushed concrete and subbase shall be as shown on the Drawings.

2.2.2.3 Subsoil Excavation and Handling

Subsoils beneath the concrete pad will be excavated to an initial depth of 9 feet below the top of the pad, subject to the excavation limits set in Section 2.2.2.4. The excavation floor area will be a projection vertically downward from the edge of the concrete pad. The eastern area of the excavation, extending approximately 40 feet west of the eastern remedial boundary, will require a sheetpile cutoff wall and internal dewatering of the sand waterbearing zone to assure stability of the excavation. The remaining excavation area will be an open cut with sloped sides in accordance with OSHA 1926 Subpart P - Excavations. The excavation will be developed and backfilled in stages to minimize the potential for rainwater accumulation. Two stages of excavation are anticipated:

1. Cutoff Walls (Eastern Pad Area)
2. Open Excavation (Western Pad Area)

Before excavation begins, an Indiana-registered engineer specializing in geotechnical engineering will provide a written determination of the maximum safe depth for excavation in the Concrete Pad Area for review and concurrence by U.S. EPA and IDEM.

The northern face of both the areas will be sloped at 3H:1V to accommodate placement of a membrane barrier (see Section 2.2.2.7). The Drawings depicts the excavation plan in the southern concrete pad area and the materials placement plan for the northern site area.

Once the 9-foot limit of excavation is achieved in each stage of excavation, the supplemental excavation assessment will be performed and exit soil sampling may be conducted by U.S. EPA or IDEM (see Section 2.2.2.4). The soil analytical results will be assessed to determine the need for capping the excavation area (see Section 2.2.2.10).

2.2.2.3.1 Excavation Stability and Cutoff Walls

The excavation was evaluated for stability against hydrostatic uplift and shear failure by stress relief. Calculations are contained in Appendix A. The data from the concrete pad area investigation, November, 1994, indicates that the sand waterbearing zone may be as shallow as 8 feet BGS at the eastern edge of the concrete pad (wellpoint OW-4). The top of the sand zone was also determined to slope downward towards the western edge of the concrete pad. Wellpoint OW-3 in this area located the top of the sand zone at 20 feet BGS. In both locations, the hydrostatic head in the sand zone is approximately 6 feet BGS. The sand zone depth in the middle of the concrete pad has not been determined, however, for evaluation purposes, the top of the sand zone has been shown as a sloped line between wellpoints OW-3 and OW-4.

The excavation stability evaluations indicate the following:

- For open excavations, a minimum 4-foot thick soil cover is necessary between the excavation floor and the top of the sand waterbearing zone to prevent excavation bottom uplift. The factor of safety against failure for this condition is 1.4; and
- All open excavations with less than a 4-foot thick soil cover above the sand waterbearing zone will require a cutoff wall into the sand with internal dewatering to reduce the hydrostatic head within the sand to the elevation of the excavation floor or lower to prevent excavation bottom uplift.

A steel sheet cutoff wall shall be included in the approximately 40-foot width of the eastern excavation area based on the current subsurface data. The cutoff wall shall extend into and through the sand waterbearing zone to reduce groundwater seepage into the excavation area. The inside of the cutoff wall shall be dewatered to maintain a reduced hydrostatic head in the sand zone to the elevation of the excavation floor, or less, during excavation of this area and until placement of 3 feet of backfill in the excavation in this area. Excavation dewatering liquids shall be handled as described in Section 2.2.2.5.

To confirm the preliminary alignment of the cutoff wall, additional wellpoints shall be installed by the Remedial Contractor into the sand waterbearing zone in the area of the southern concrete pad prior to proceeding with subsoil excavation. The Contractor will use drilling methods that will allow continuous sampling of the soil materials to determine the soil lithology and the well point depth and construction. The well points will be used to determine the sand zone depth and its potentiometric surface within the area of the concrete pad. This data will be used to confirm the preliminary excavation stability evaluation and the location of the sheetpile cutoff wall. The well point findings and the confirmatory excavation stability analyses will be provided to the Enviro-Chem Trustees, the Indiana-registered geotechnical engineer, U.S. EPA, and IDEM for review, and any proposed changes to the excavation design and operations will be approved by U.S. EPA and IDEM prior to proceeding with excavation.

2.2.2.3.2 Excavation Approach

Cutoff Wall Area (Eastern Pad)—The eastern area within the cutoff wall will be excavated first. Once the cutoff wall is in place and adequate dewatering has occurred, the excavation of the concrete pad subsoil within this area will then be performed. Typical construction excavation equipment and methods will be used. It is anticipated that excavating equipment will work within and outside of the cutoff wall area to remove the soils to a depth of 9 feet, subject to the excavation limits set in Section 2.2.2.4. The HDPE liner segment inside of the cutoff wall shall be placed on the north end of the cutoff wall area upon completion of excavation. Wellpoint dewatering will be maintained during excavation and until a minimum 3 feet of backfill soil is placed across the entire excavation floor. The cutoff wall area backfill will commence after placement of the HDPE liner and prior to removal of the sheetpiles, and after completion of any exit soil sampling. Removal of the east, north, and south sheetpile walls can be initiated after placement of 4 feet of backfill soil. The west cutoff wall will remain in place until the adjoining open cut area is backfilled to grade on the west side of the wall.

Open Excavation Area (Western Pad)—The open, unbraced excavation area to the west of the cutoff wall will be approximately 110 feet by 240 feet based on the preliminary alignment of the cutoff wall. This area will be excavated in at least two stages, each approximately 55 feet by 240 feet, to minimize the open area that is exposed to direct rainfall.

The open excavation side slopes in the western pad area will be sloped at a minimum safe angle per OSHA requirements, except for the northern face which will be cut at a flatter slope to accommodate the low permeability barrier. Design slopes are ¾H:1V on the east, west and south excavation faces, and 3H:1V on the northern face. The soil excavation and handling and excavation backfill operations will be conducted on a fast-track construction schedule to minimize the time period when the excavation is open and precipitation may occur. Preliminary estimates are 10 to 15 days for excavation and backfilling, assuming no unforeseen subsurface conditions or excessive rainfall.

The excavating sequence will be performed such that backfilling operations immediately follow behind the excavation stage once the exit soil samples have been taken (see Section 2.2.2.4) and the low permeability barrier is installed (see Section 2.2.2.7) in each area, respectively. Backfill will be undertaken to complete the excavation activities at the earliest possible time to minimize the risk of rainfall and runoff accumulation in the working excavation and will not await or be affected by sampling results.

Exit soil sampling results will determine whether the installation of a RCRA-compliant cover or covers will be needed over the area (see Section 2.2.2.10). Any surface water or precipitation that enters the excavation will be collected for subsequent treatment (see Section 2.2.4).

2.2.2.3.3 Excavated Soils Placement

Excavated soils will be placed on the northern site area in the designated soil fill zones which will be segregated from the crushed concrete/aggregate fill areas for purposes of SVE treatment. Subsoil excavation volume based on the 9-foot BGS excavation depth is estimated at 9,772 cubic yards (see Appendix A, calculations). Fill capacity of the northern fill zone for soils is 12,777 cubic yards, which results in an approximate 20 percent allowance for additional excavation volume. This additional fill capacity is adequate for an estimated 10 percent bulking factor for placement of fill at less than in-situ density plus a 1-foot deep supplemental excavation across the excavation floor. The soil fill will be compacted by the action of the earthmoving and grading equipment, however, no additional compactive effort will be made unless required by the Remedial Contractor for the SVE method selected for the Revised Remedial Action. Soil compaction tests will be performed prior to construction to specify fill placement requirements.

Excavation and soil placement operations will be monitored for particulate and volatile organic compound vapor emissions in accordance with the Air Monitoring Plan (see Section 2.2.2.8). Dust and vapor control measures will be implemented, if necessary, based on the results of the ongoing air monitoring. The Air Monitoring Plan addresses contingency measures for suppression of excessive dust and VOC vapor releases.

2.2.2.4 Supplemental Excavation Assessment and Exit Soil Sampling

A supplemental excavation assessment will be performed in the excavation floor areas when the target depth of 9 feet has been reached in that area. Deeper excavations may be implemented and they will be performed if necessary, based on the assessment procedure described in revised Exhibit A, Section 2.1.1. The assessments will be performed in each excavation area corresponding to the excavation staging as proposed by the Contractor and approved by the Enviro-Chem Trustee's Engineer. At a minimum, two excavation stages will be required. These include the cutoff wall area and the western pad area open cut. Supplemental excavations, if performed, will not exceed the maximum safe excavation depth determined as described in Section 2.2.2.3.1. Once the excavation stage is completed, including any supplemental excavations, exit soil sampling may be conducted by U.S. EPA, if they desire to do so, on the excavation floor and sides. Samples shall be split with the Enviro-Chem Trustee's Engineer.

The methodology for assessment of supplemental excavations and exit soil sampling will be as follows:

1. Visual Inspection – A visual inspection will be performed of the excavation floor at the 9-foot level for indicators of contamination, including soil staining, oily or non-aqueous chemical product presence, or semi-solid or solid waste product presence. Any visible contamination remaining at the 9-foot level will be excavated, but any such excavation will not exceed the maximum safe depth as determined in accordance with Section 2.2.2.3.

2. Field Readings – In addition, after excavation to the 9-foot level, field readings will be taken. If there is agreement among the representatives of the Enviro-Chem Trustees, U.S. EPA, and IDEM, then additional excavation will be undertaken based on the results of field instrumentation, provided that the excavation is deemed safe and practicable in accordance with the maximum safe depth as determined in accordance with Section 2.2.2.3. In the event that the representative of the ECC Trustees does not agree, no further excavation will be performed except for the removal of visible contamination to the extent required by Item 1 above.

3. Exit Soil Sampling and Field Analyses – Soil samples may be taken by U.S. EPA/IDEM over the floor and sidewalls of each excavation stage at locations determined by U.S. EPA/IDEM in cooperation with the Trustees. Each excavation

stage will be backfilled as soon as possible after soil samples have been taken without awaiting results. The exit soil sample analytical results, if obtained, will be analyzed to determine the need for capping the excavation area (see Section 2.2.2.10).

The Trustees will provide reasonable assistance to the Agencies in their collection of these exit samples, including sampling of the sidewalls of the excavation. The Agencies have also agreed to conduct exit sample collection promptly after each excavation stage so as not to delay the backfilling process. Any samples taken will be split with the Trustees.

Contamination of the southern concrete pad will be excavated to the limits required by the consent decree. If exit soil sampling shows that the sidewalls are still contaminated above RCRA clean closure criteria, the trustees will determine the extent of sidewall contamination and the extent to which the excavation can be practicably extended. If contamination exists beyond the boundaries where excavation can reasonably be extended, it will be addressed by extending the RCRA complaint cover over the lateral extent of the contamination. This agreement applies up to but not beyond Unnamed Ditch to the east, up to but not beyond the support zone to the west, and up to but not beyond the roadway to the south.

It was agreed at the January 13, 1997 meeting that in order for U.S. EPA and/or its consultant to collect exit sampling, the completed excavation area will remain open for one day before backfilling. It was also agreed that the excavation area will remain open for a second day if samples are not collected on the first day. The request to keep the excavation open for a second day will be made by U.S. EPA to the Settling Defendants either in writing or verbally.

2.2.2.5 Excavation Dewatering

All water collected within the southern concrete pad excavation area will be pumped to temporary storage on-site, treated on-site and then either discharged to surface water in accordance with applicable regulatory requirements or disposed of off-site (see Section 2.2.4).

Excavation dewatering will be required as follows:

1. Open pumping of ponded water on the concrete pad (if present) and from the concrete pad subbase by means of sump pumps.

2. Predrainage dewatering of the sand waterbearing zone within the sheetpile cutoff wall (prior to excavation) by means of wellpoints.

3. Dewatering of the sand waterbearing zone during excavation inside the sheetpile cutoff wall, and until backfill of at least 3 feet of compacted soil fill, by means of wellpoints.

4. Open pumping of seepage water and rainwater from the excavation, by means of sump pumps, as necessary.

Estimates of the volume of groundwater that may require management during excavation are contained in Appendix A. Actual volumes may vary.

2.2.2.6 Stormwater Management in Northern Fill Area

The fill placement in the northern site area is designed to minimize its contact with stormwater and ponded water. This will be accomplished by the following:

1. The crushed concrete/subbase aggregate and soil from the southern concrete pad area will be placed to finished grades as soon as practicable and covered with the Stage 1 final cover on an accelerated work schedule to minimize the potential for rainfall coming into contact with the placed fill.

2. Temporary impermeable covers shall be placed on fill areas that have not been covered with Stage 1 final cover soils to divert stormwater runoff.

3. Ponded stormwater encountered in the northern site area shall be removed by pumping prior to placement of any fill. The waters shall be pumped to temporary storage facilities on-site for subsequent off-site disposal or on-site treatment in accordance with applicable regulatory requirements.

The fill materials shall be placed to finished grade and covered with soil starting from the northern edge of the site. Fill areas capped with the Stage 1 cover are designed to convey runoff from the covered areas into the site diversion channel system. Temporary fill covers will be placed over finished grade fill areas not yet covered to minimize the volume of stormwater in contact with the fill materials.

2.2.2.7 Excavation Area Barrier

A 60 mil HDPE liner will be placed between the excavation and SVE treatment area. The barrier will be installed in each excavation stage prior to backfilling.

The general barrier installation approach is as follows:

- The barrier will be placed as soon as possible after the completion of the excavation and post-excavation soil sampling in each stage of the southern concrete pad area excavation (see Section 2.2.2.4);

- The northern sidewall of the area of excavation will be covered by the barrier and shall be sloped uniformly at 3H:1V, or steeper if possible based on engineering analyses of barrier stability; and

- A suitable anchor trench will be constructed at the top of the slope to anchor the barrier firmly in place during the backfilling process.

2.2.2.8 Air Monitoring

Air monitoring shall be performed during excavation and material placement in accordance with the Air Monitoring Plan (Appendix H). This plan is based in part on the results of a human health risk assessment that evaluated potential exposures during construction activities. Air monitoring will be conducted for particulates and VOC vapor emissions. The risk assessment calculations have been provided to U.S. EPA in a May, 1995 submittal.

2.2.2.9 Excavation Backfill

After the excavation has been completed and after exit soil samples have been taken in an excavation stage (if performed), the excavation will be backfilled to at least the top of the former concrete pad. Clean, native clayey soil from an off-site borrow source will be used to fill the excavation. To minimize the volume of water for management, each excavation stage will be backfilled within one working day of the conclusion of excavation in that stage. However, if U.S. EPA's exit soil sampling is not complete within one working day after excavation and a one-day delay to complete sampling is requested in writing or verbally by U.S. EPA's OSC before backfilling is commenced, the backfilling of that stage may be delayed for up to one working day. In such event, backfilling must be completed no later than two working days after the conclusion of excavation in each excavation stage. The prospective borrow soils will be analyzed for site contaminants to confirm that the backfill materials will be uncontaminated.

Each excavation stage will be backfilled as excavation activities and HDPE liner installations are finished to expedite completion of the southern concrete pad Revised Remedial Action. Backfill stages will correspond with the excavation staging (see Section 2.2.2.3). The native soil materials will be placed in thin lifts (12 inches or less), and compacted with sheepsfoot-type compactors. The backfill will be brought to the final grade and sloped to drain as appropriate. A 1-foot thick layer of topsoil shall be placed on top, and the entire area appropriately seeded with native grasses. The final ground surface elevation will be designed at higher than currently existing elevation, to facilitate runoff and prevent ponding. A RCRA-compliant cover may (or may not) be placed on the backfill based on the results of any exit soil sampling (see Section 2.2.2.10).

2.2.2.10 Excavation Area RCRA-Compliant Cover

If exit soil sample analytical results exceed the RCRA clean closure standards, the portion or portions of the excavation area that exceed RCRA clean closure values will be capped with a RCRA-compliant cover or covers. Any RCRA-compliant cover or covers placed over the excavation area will be continuous with the RCRA-compliant cover in the northern part of the site. Any RCRA-compliant cover or covers will be the same as the final cover (Stage 2) design for the SVE treatment area (see Section 2.2.6).

If no exit sampling is conducted by U.S. EPA/IDEM, or if sampling data do not exceed the RCRA clean closure criteria, then no RCRA-compliant cover or covers will be required over the excavated area. Portions of the excavation area that do not exceed RCRA clean closure standards need not be capped, unless located between an area of residual contamination and the northern RCRA-compliant cover. Final cover soils in areas not capped would consist of topsoil and vegetation placed on the backfill soil.

2.2.3 Other Concrete Pads and Foundations

The northern concrete pad near the former facility entrance, the facility process building floor slab and foundation, and associated subbase aggregates will also be excavated, crushed, and placed on-site with the southern concrete pad materials for SVE treatment. The physical characteristics of these materials, such as slab thickness and reinforcing, footer type, and subbase aggregate thickness have not yet been determined, but are expected to be roughly comparable to the southern concrete pad.

Preliminary volume estimates based on a 4-inch slab thickness and 18 inches of subbase aggregate are as follows:

- Process Building
  - 150 cubic yards (300 tons) concrete
  - 150 cubic yards (250 tons) subbase aggregate

- Northern Concrete Pad
  - 100 cubic yards (200 tons) concrete
  - 150 cubic yards (250 tons) subbase aggregate

2.2.4 Water Management

Waters collected during construction activities and in the SVE system during construction and operation of the RRA will be pumped to temporary storage and will be treated on-site and discharged to surface water in accordance with applicable Federal and state regulations or disposed of off-site at an acceptable facility. Any water hauled off-site will be tested for TCLP and other parameters as required by the disposal facility. Waters that will be collected will include at least the following:

1. Groundwater and precipitation generated from dewatering of the southern concrete pad excavation area.

2. Ponded waters collected within the northern fill area and the concrete pads.

3. Water encountered during construction and operation of the SVE system.

A summary of estimated water volumes is shown on Table 2-1.

Table 2-1. Estimated Water Volumes

Source	Volume Est. Gal		Pumping Period[A]	Pumping Flow (gpm)[B]		Basis of Estimate
	Low	High	Days	Low	High	
1.0 CONSTRUCTION						
1.1 Ponded (Southern Pad)	0	81,500	1	0	57	High volume based on an average of six-inches of water over 0.5 acres.
1.2 Concrete Pad Subbase	105,500		1	83		Phase II SI Report, AWD, 3/93
1.3 Dewatering Open Excavation (Concrete Pad)	0	100,000	1	0	69	High volume based on four inches of rain over 40K square foot area.
Sand Zone	10,800	108,000	15	0.5	5.0	Design Calc. 4.2
SVE System Construction	25,920	47,520	30	0.6	1.1	Design Calc. 4.1 applied to construction period.
Subtotal 1.0	**142,220**	**442,520**				
2.0 OPERATIONS						
2.1 SVE Dewatering	630,720	1,156,320	730	0.6	1.1	Design Calc. 4.1
TOTAL	**772,940**	**1,598,840**				

NOTES:
A. Pumping period is the time estimated to convey water from the source to onsite storage.
B. Flow estimate is based on removal of water volume estimates over pumping period. Actual pumping flow rate will depend on the available water storage capacity.

On-site treatment and discharge will be the primary approach for management of site waters. Hauling will be used as a backup disposal option if discharge limits are not achieved and on-site storage capacity is exceeded. On-site discharge will be implemented as soon as construction has started. Waters are to be treated in the activated carbon system. The treated effluent will be analyzed to obtain representative data on water quality. Discharge shall be on-site into a support zone diversion channel as shown on Drawing C-14. Routine discharge sampling will be performed on a schedule as described in the Technical Specifications and as approved by the agencies. No discharge shall occur that exceeds IDEM approved discharge limits.

2.2.4.1 Estimated Water Volumes

2.2.4.1.1 Concrete Subbase

A total of 105,500 gallons of water has been estimated to be contained in the gravel subbase of the southern concrete pad (Phase II Supplemental Investigation Report). This water will be pumped out during removal of the concrete pad and subbase (see Section 2.2.2.2).

2.2.4.1.2 Rainfall

In the southern concrete pad excavation area, the exact volume of additional water generated from direct precipitation cannot be accurately estimated because of the uncertainty in predicting precipitation events, however, it is estimated to be less than 100,000 gallons based on a single 10-year storm (approximately 4 inches) occurring over the excavation period. To minimize the potential for direct rainfall accumulation, excavation and backfill shall be performed in stages and shall be as fast as practical for site conditions. To accomplish this, double work shifts shall be used. If U.S. EPA and IDEM elect to conduct exit sampling, they will do so separately for each excavation stage on an expedited basis so as not to delay backfilling (see Section 2.2.2.4).

Ponded water volumes in the northern fill area also cannot be accurately estimated for the same reasons. A single 10-year storm event over the fill area would result in approximately 200,000 gallons of water, however, the majority of this water is expected to either be diverted by the temporary fill covers or be runoff from unfilled areas, as is the present site condition.

Ponded water is present on the southern concrete pad on a seasonal basis. Maximum ponded area as observed by DEI over the past 3 years is half of the pad, or approximately 0.5 acres. At an average water depth of six inches, this is equivalent to 81,500 gallons.

2.2.4.1.3 Construction Dewatering

Groundwater will be pumped from the sand waterbearing zone within the sheetpile cutoff wall to reduce the potentiometric head during excavation and backfill. Pumping will need to be started prior to excavation to allow time to achieve sufficient drawdown. The volume of groundwater pumped from the sand zone, and the time required for pumping, cannot be accurately estimated at this time because waterbearing zone hydraulic characteristics are not well-defined and sheetpile leakage rates cannot be accurately determined until after field installation. Preliminary estimations based on DEI experience indicate that a dewatering rate of 0.5 to 5.0 gallons per minute (gpm) would be required over a 15-day period (5-day predrainage and 10-day excavation dewatering). These calculations are based on limited data presented in the Remedial Investigation Report and the use of either AZ, BZ, or Z sheet sections. Dewatering Calculations are presented in the Appendix A calculations.

2.2.4.1.4 SVE Operations

Operational dewatering volumes from the SVE system, have been estimated at 0.6 to 1.1 gpm, or approximately 860 to 1,600 gallons per day (gpd) (see Appendix A calculations). This water shall be removed as part of the SVE system operation.

2.2.4.2 Wastewater Storage and Transfer System

A wastewater storage system and transfer system will be employed on-site to handle all waters generated during RRA construction and SVE operations. Four 150,000-gallon storage tanks (total capacity of 600,000 gallons) shall be placed in the support zone to receive all liquids pumped from the site as shown on the Drawings. Two tanks will be designated for raw water storage and two tanks will be used for treated effluent storage. One of the effluent tanks is designed to also serve as an optional raw water storage tank.

One raw water tank shall be designated as the surge tank which will receive all dewatering liquids from the site and provide a means to remove settleable solids prior to treatment. Overflow riser drains will be provided in the storage tanks to minimize the carryover of solids to the treatment system. Waters shall be treated on-site (See Section 2.2.4.3.) and discharged into the effluent storage tanks. The final effluent storage tank is designated as the transfer tank and will be used to convey wastewaters either to on-site discharge or to a tanker truck that will be loaded on the wastewater storage pad. The tanker truck may be used if needed for off-site disposal.

The wastewater storage system normal operation is designed to provide a minimum storage capacity of 70 percent of the maximum raw water volume estimated during the construction. The storage capacity can be increased, if necessary, by using the effluent tank by-pass option designed into the storage system. This will allow one of the two effluent tanks to act as a raw water storage tank to increase the total raw water storage volume to 450,000 gallons. This option would be initiated as a contingency in the event of excessive water volumes or temporary shutdown of the on-site treatment system.

Collected solids accumulating in the raw water Storage tanks will be removed (if necessary) from either tank upon reaching a settled level equivalent to 30 percent of the tank capacity. Solids shall be disposed of on-site beneath the Stage 1 final cover in the northern part of the Site or hauled off-site for disposal at a suitable facility, if necessary, as described in the Specifications.

Pumps and piping shall be included for transfer of waters from the Storage tanks into the treatment system and from the transfer tank to on-site discharge or tank trucks. The daily volume of water discharged on-site or into the tank trucks shall be metered and the Remedial Contractor shall maintain a daily log of pumped water volumes.

2.2.4.3 On-site Wastewater Treatment

On-site wastewater treatment shall be employed in the RRA. All collected waters shall be treated prior to on-site discharge to assure that hazardous constituents are removed to acceptable levels. Treatment will also enable waters to meet TCLP limits, if the waters are to be hauled off-site for non-RCRA disposal.

2.2.4.3.1 Preliminary Effluent Limits

Preliminary effluent limits for on-site discharge have been provided by IDEM Office of Water Management. See Table 2-2. These preliminary limits are based on discharge to Finley Creek or one of its tributary streams (unnamed ditch). The seven consecutive day 10-year low flow (Q7,10) of Finley Creek is zero, which does not allow for any mixing zone dilution in calculation of the effluent limits. These preliminary limits are subject to change based on ongoing negotiations with IDEM. Final limits may be different.

Table 2-2 also contains a number of chemical analyses of site water samples from sources most likely to be representative of the water that will be generated during the RRA. These sources include concrete pad overflow water from 1985 EPA removal action, Remedial Investigation monitoring wells in the shallow till and sand water-bearing zones adjacent to the southern concrete pad, and waters from beneath the southern concrete pad as sampled in test pits during the Phase II Supplemental Investigation, 1993. These analytical results were used to evaluate treatment options and treatment system effectiveness.

An IDEM discharge permit is not needed for discharge from a CERCLA site, however, the IDEM effluent limits are considered ARARs to be met by the RRA. Final effluent limits and conditions for discharge, including monitoring requirements, are expected to be provided by IDEM prior to completion of the Final Design.

2.2.4.3.2 Wastewater Treatment System

On-site wastewater treatment will be accomplished by air stripping and activated carbon adsorption for dissolved organics removal with pre-filtration to remove suspended solids. The air stripper shall remove the primary organic fraction from the wastewater and the activated carbon will "polish" the wastewater to meet discharge limits. Carbon adsorption is best suited for removal of organic contaminants at low concentrations in water as anticipated in the stripper effluent. Dual module adsorbers operated in series shall be used. The adsorbers can be operated in batch or continuous mode, which allows maximum user flexibility. Pre-filtration shall be used for suspended solids removal to reduce loading on the adsorbers. A bubble diffuser aeration

Table 2-2. Preliminary Effluent Limits and Historic Site Water Quality

Parameter	IDEM Preliminary Effluent Limits[1]		Consent Decree[2] for Stream Concentrations µg/l	Site Water Samples and Concentrations (µg/l)[3]					
				EPA Removal Action, 1985					
	Average µg/l	Maximum µg/l		S.E. Corner of East Drainage Ditch	West Drainage Ditch	Phase II SI CP-TP-01	Well 10A (Sand)	Well 8A (Sand	Well 11A (Till)
Volatile Organics									
Acetone	6800	16000	N/A	12000		<1000	53	52	(5)
Chlorobenzene	177	411	N/A	(5)		<50			
Chloroethane	N/A[4]	N/A	N/A			290	29		
Chloroform	94	218	15.7	12700		430			
1,2-Dichlorobenzene	N/A	N/A	N/A			(5)			
1,1-Dichloroethane	N/A	N/A	N/A	600		5700			
1,1-Dichloroethene	13	30	1.85			310	8	6	
1,2-Dichloroethane	1412	3285	N/A			67			
1,2-Dichloroethene (total)	---	---	N/A			34000			
Ethylbenzene	439	1022	3280			470			
Methylene Chloride	352	818	15.7	12000	130	1200	4	64	
Methyl Ethyl Ketone	N/A	N/A	N/A			<1000	26		
Methyl Isobutyl Ketone	N/A	N/A	N/A						
Tetrachlorethene	62	145	8.85			71			

Table 2-2. Preliminary Effluent Limits and Historic Site Water Quality (Continued)

Parameter	IDEM Preliminary Effluent Limits[1]		Consent Decree[2] for Stream Concentrations µg/l	Site Water Samples and Concentrations (µg/l)[3]					
				EPA Removal Action, 1985					
	Average µg/l	Maximum µg/l		S.E. Corner of East Drainage Ditch	West Drainage Ditch	Phase II SI CP-TP-01	Well 10A (Sand)	Well 8A (Sand	Well 11A (Till)
Toluene	205	478	3400	1900	84	2200			
Trans-1,2-Dichloroethene	N/A	N/A	N/A	8600	62		3	13	4000
1,1,1-Trichloroethane	109	255	5280	15000	110	14000		7	
1,1,2-Trichloroethane	293	682	41.8			120			
Trichloroethene	70	163	80.7	4600	140	1300		21	28000
Trichlorofluoromethane	N/A	N/A	N/A			100			
1,1,2-Trichloro-1,2,2-Trifluoroethane	---	---	N/A	310					
Vinyl Chloride	3704	8617	N/A			340			
Total Xylenes	477	1109	N/A			3400			
Base Neutral/Acid Organics									
Bis(2-ethylhexyl)phthalate	254	591	50000			27			
Butylbenzylphthalate	18.4	42.7	N/A			11			
Di-n-Butylphthalate	8.97	20.9	154000			<10			
1,2-Dichlorobenzene	N/A	N/A	N/A			21			
Diethylphthalate	1270908	2956804	52100			400			
2,4-Dimethylphenol	22.1	51.4	N/A			77			

Table 2-2. Preliminary Effluent Limits and Historic Site Water Quality (Continued)

Parameter	IDEM Preliminary Effluent Limits[1] Average µg/l	IDEM Preliminary Effluent Limits[1] Maximum µg/l	Consent Decree[2] for Stream Concentrations µg/l	Site Water Samples and Concentrations (µg/l)[3] — EPA Removal Action, 1985: S.E. Corner of East Drainage Ditch	EPA Removal Action, 1985: West Drainage Ditch	Phase II SI CP-TP-01	Well 10A (Sand)	Well 8A (Sand	Well 11A (Till)
Dimethylphthalate	2047574	4763740	N/A			14			
Isophorone	3059	7118	N/A			55			
Naphthalene	29.7	69	620			21			
Phenol	472	1099	570			140			
Inorganics									
pH (Standard Units)	---	---	N/A			7.33			
Specific Conductance (umhos/cm)	---	---	N/A			843			
Aluminum	172	399	N/A				72	144	
Antimony	21.2	49.3	N/A			<5			
Arsenic	0.12 (III)	0.29 (III)	0.0175			6			
Barium	N/A	N/A	N/A			200	298	353	
Beryllium	0.83	1.92	N/A			<10			
Cadmium	1.8	4.1	N/A			<10			
Calcium	N/A	N/A	N/A				77000	98580	
Chromium VI	7.8	18.1	11			<20			
Iron	706	1643	N/A				51	2545	

Table 2-2. Preliminary Effluent Limits and Historic Site Water Quality (Continued)

Parameter	IDEM Preliminary Effluent Limits[1] Average µg/l	IDEM Preliminary Effluent Limits[1] Maximum µg/l	Consent Decree[2] for Stream Concentrations µg/l	Site Water Samples and Concentrations (µg/l)[3]: EPA Removal Action, 1985 – S.E. Corner of East Drainage Ditch	EPA Removal Action, 1985 – West Drainage Ditch	Phase II SI CP-TP-01	Well 10A (Sand)	Well 8A (Sand	Well 11A (Till)
Lead	8.2	19.0	10			28			
Magnesium	N/A	N/A	N/A				31440	38890	
Manganese	N/A	N/A	N/A			410	40	24	
Nickel	70.6	164.3	100			<50			
Potassium	N/A	N/A	N/A				4765	1195	
Silver	1.6	3.7	N/A			<20			
Sodium	N/A	N/A	N/A				25520	15130	
Tin	N/A	N/A	N/A			<300			
Vanadium	---	---	N/A			<10			
Zinc	177	412	47			50		69	
Cyanide (total)	3.7	8.5	5.2			6			
Dissolved Solids (Total)	529545	1232002	N/A						
Pesticides/PCBs									
Total PCBs	0.00056	0.0013	0.000079			0.6			

NOTES
1. Preliminary effluent limits from IDEM Office of Water Management, 10/13/95. The limits are based on a receiving stream Q7,10 of 0 CFS.
2. Consent Decree, Exhibit A, Table 3-1, including footnotes 3, 4, 7 and 8.

Table 2-2. Preliminary Effluent Limits and Historic Site Water Quality (Continued)

3. Site Water Samples:
   a. EPA Removal Action (U.S. EPA OSC, 1985) - East drainage ditch sample is from the present unnamed ditch at a point downstream of the site concrete pad overflow. West drainage ditch sample is from the former ditch adjacent to the southern concrete pad, downstream of the concrete pad overflow.
   b. Phase II Supplemental Investigation (AWD, 1993) - Sample CP-TP-01 is from a test pit excavated through the southern concrete pad which received water flow from the pad subbase aggregate.
   c. Remedial Investigation (U.S. EPA, 1986) - Monitoring Well 10A is directly south of the southern concrete pad and is screened in the sand waterbearing zone approximately 15-20 feet BGS. Monitoring Well 8A is on the eastern edge of the southern concrete pad and is screened in the sand waterbearing zone approximately 20-25 feet BGS. Monitoring Well 11A is on the southwest corner of the southern concrete pad and is screened in the shallow till approximately 10-15 feet BGS. Inorganic analyses was not performed on Well 11A.
4. N/A - No standard or limit provided.
5. No entry indicates BDL - Below Detectable Limits.

system will be installed in the raw water storage tank T2 to provide supplemental aeration for iron oxidation. The treatment system shall be located in a building between the wastewater storage tanks as shown on the Drawings.

The wastewater treatment system capacity is 50 gpm, which is a maximum flow rate based on processing the volume of one storage tank (150,000 gallons) in six (6) working days, assuming eight (8) hours of operation per day. The actual hours of operation over the construction and SVE operations periods are expected to be significantly less than 50 hours per week since the total maximum volumes of wastewater generated during those periods are estimated at 0.44 and 1.2 million gallons, respectively. See Table 2-1.

Based on the Phase II SI analytical results as contained in Table 2-2 (January 10, 1993, sample date for concrete pad test pit sample CP-TP-01) Calgon Carbon estimated that up to 14.2 pounds of activated carbon would be required per 1000 gallons of raw untreated water to remove VOCs to detectable limits. Calgon Carbon indicated that based on the organic constituents present in sample CP-TP-01, the site waters are readily treated by activated carbon adsorption. Bench-scale testing was not performed. Calgon has a large database on chemical treatability of volatile organics and computer simulations were performed to estimate carbon use.

Because of the potential to use relatively high amounts of carbon to treat the raw wastewater, the pretreatment of the water with an air stripper was evaluated and determined to be a cost-effective approach to meet possible discharge limits that are lower than the preliminary limits summarized on Table 2-2.

Based on the Phase II SI analytical results as used by Calgon Carbon, Carbonair Corp. estimated that 0.25 pounds of activated carbon would be required per 1000 gallons of <u>stripped</u> wastewater to remove VOC's and SVOC's to low discharge limits.

A potential problem with carbon treatment is iron precipitation on the carbon bed and the pre-filter media. Generally, one ppm or greater of ferrous iron (non-oxidized) dissolved in the water can potentially cause fouling by iron, depending on the water chemistry. The existing data from the RI indicates groundwater iron levels range from 0.1 to 12.5 ppm. Average concentration is approximately 3 ppm. It is not clear whether the samples were filtered or not, therefore, it is not known if the iron is only in the dissolved form. By assuming the iron is dissolved (worst-case), there is a potential iron fouling problem with on-site treatment.

Ferrous iron can be readily precipitated by oxidizing the iron during storage through mixing or aeration of the Storage ponds. Discharge of the wastewaters into open storage tanks is expected to provide sufficient aeration for the anticipated water chemistry. To supplement this aeration and provide an added factor of safety, a submerged bubble diffuser aeration system shall be installed in storage tank T2 to increase iron oxidation and minimize iron fouling in the air stripper and carbon sorbers.

Because of the limited data on actual wastewater characteristics, the design includes specifications for contingency treatment systems for chemical oxidation of iron and removal of oil and grease. These contingency systems will not be constructed initially as part of the treatment system. They will be implemented, if needed, based on performance of the wastewater treatment system during construction and operation of the remedial action.

2.2.4.3.3 Treated Effluent Monitoring and Discharge

The treated wastewaters will be discharged into the on-site channel designated as the northern support zone diversion. The discharge will be monitored in accordance with the IDEM approved monitoring plan prepared with the Final Design. Effluent discharge will be metered and sampled only during periods when the Contractor the Engineer is present on-site.

2.2.4.4 Off-site Disposal Option

Off-site disposal of waters will be implemented if both (A): the treated water does not meet IDEM effluent limitations or if the Wastewater treatment system is shut down and (B): the on-site water storage capacity is exceeded. The on-site tanker truck shall be considered additional temporary storage capacity. In the event of off-site disposal, the water shall be hauled to an off-site TSD. The waters will require additional analytical testing as required by the disposal facility.

In order to maintain the operation of the SVE system, it may under certain conditions, be necessary to dispose waters off-site in accordance with Section 2.1.2 of the revised Exhibit A.

Off-site disposal will terminate as soon as on-site treatment operations and storage capacity allows for resumption of on-site water management.

2.2.5 Soil Vapor Extraction System

Soil Vapor Extraction (SVE) will be used to remove VOCs from both the insitu soils north of the southern concrete pad and the crushed concrete/soil fill placed on top of the insitu soils. The fill will be segregated by placing the coarse crushed concrete and subbase aggregate in a separate zone on the northern edge of the site. Excavated soils will be placed adjacent to and in contact with the coarse material fill as shown on the Drawings.

The SVE System Final (100%) Design includes a performance specification. The Final SVE System Design will be prepared by the successful bidder. The performance specification contains criteria for the SVE system zone of treatment and cleanup verification, and general requirements for the system process and mechanical design and operation and maintenance. Prior to the selection of the SVE successful bidder, the Trustees will conduct informal discussions with U.S. EPA and IDEM to obtain their conceptual-level concurrence regarding the proposed approach for SVE system design. U.S. EPA will have a "second look" opportunity to review and approve the Final (100%) SVE Design (including the O&M plan for the SVE system) pursuant to the Consent Decree as amended, when that SVE Design is later submitted.

The SVE system is intended to systematically move air through the zone of contamination to enhance volatilization and hence removal of volatile organics. Air movement through the soil may be controlled by a network of vertical trenches, wellpoints, a combination of both, or other means installed in the contaminated soils and crushed concrete/aggregate. Saturated conditions in the in-situ soils zone of treatment and any leachate water present in the contaminated fill will be addressed by means of water collection and removal systems which may be integrated with the SVE system depending on the Contractor's design approach. Water which is collected by the SVE System shall be conveyed to the on-site storage tanks and treated (see Section 2.2.4.3.2). The SVE process also involves the continuous extraction of organics-laden air and treatment of the air by activated carbon to remove the organics. The organics so collected will then be destroyed off-site in conformance with applicable Federal and state requirements.

The potential effectiveness of vapor extraction for organics removal from the Enviro-Chem Site soils was demonstrated during a SVE trench pilot test conducted by Terra Vac in June 1988. The description of the pilot test, including the results obtained, was previously submitted to U.S. EPA and IDEM. The test showed an initial high organics extraction rate of 1.9 pounds per day per foot of trench that decreased over the course of the pilot test to a steady state rate of approximately 0.25 pounds per day per foot of trench. The radius of influence of the trench vacuum was estimated to be 15 to 20 feet. The Terra Vac pilot study provides useful information that may be useful concerning the air permeability of in-situ soils, the area of influence of an applied vacuum pressure in soil, and the amount of VOCs removed.

All areas within the remedial boundary except the Concrete Pad Area will be addressed by SVE. The SVE vacuum system will be capable of developing a minimum vacuum of 20 inches Hg. The normal operating vacuum will be established by the SVE contractor. The Terra Vac pilot test at the ECC site results showed an initial radius of influence of 15 feet during trench development. Under continuous operation, the radius of influence increased to about 20 feet. The enhanced operating efficiency obtained by installing the SVE Stage 1 cover should increase the radius of influence to over 20 feet. To be conservative, for purposes of the design, the radius of influence will be assumed to be 18 feet.

The design air volume (consistent with the Terra Vac pilot plant test results) criteria is to provide at least one air volume change per soil pore volume per day. Based on an estimated area of treatment of approximately 115,400 square feet, a depth of 9 feet, and an average soil porosity of 20%, 200 SCFM would be the minimum air flow that meets the design.

2.2.6 RCRA-Compliant Final Cover

A RCRA-compliant final cover shall be placed over the SVE treatment areas in the northern part of the site area. The cover will be placed in two stages as follows:

Stage 1 - SVE surface cover installed as soon as the contaminated soil and crushed concrete/aggregate fill are placed at final grade

Stage 2 - Final cover installed after completion of SVE operations and verification of soil cleanup or a decision to terminate SVE System operations.

The first stage of the cover will consist of a minimum of 3-foot of compacted, impermeable native soil and 1 foot of top soil to support vegetation. The final grading plan will ensure a minimum cover slope of 3 percent. The native soil used will be the silty clay till available in the area, which can and will be compacted by suitable methods to a maximum density as determined by ASTM D-1557-78. The compacted silty clay till will have a hydraulic conductivity of 1 x 10^{-6} cm/sec which is less than the natural tills underlying the site. If soil from the neighboring Northside Sanitary Landfill Facility borrow area is not available, material with similar performance will be obtained from another source. Topsoil will consist of friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, reasonably free from subsoil, roots, heavy or stiff clay, stones larger than 2 inches, and other deleterious matter, and capable of sustaining healthy plant life.

The Stage 1 cover will facilitate installation of SVE trenches and/or wellpoints during both construction and operation of the SVE system. Repairs to the soil cover penetrations can be easily made by either replacement of the compacted native soil or backfill with a low permeability bentonite-based grout.

The second stage final cover will consist of a geocomposite drainage net placed on top of the Stage 1 native soil layer with a minimum of 1 foot of soil fill and 1 foot of topsoil placed on top of the drainage net. The topsoil and vegetation placed for the Stage 1 cover will be stripped off, temporarily stockpiled, and then replaced on top of the 1 foot of soil fill and drainage net. The soil fill will consist of a suitable soil material, free from rock fragments greater than 2 inches, debris, and other deleterious substances.

The geocomposite drainage net will be an HDPE geonet surrounded on both sides with a nonwoven geotextile. The drainage net will have a minimum transmissivity of 0.01 ft^2/sec.

The RCRA compliant cover (Stage 2) may also be placed over the southern concrete pad area excavation based on the results of soil exit sampling (see Section 2.2.2.10). If necessary, this cover will be placed over the backfilled excavation concurrent with cover placement in the northern site area.

2.2.7 Access Restrictions

Access restrictions have been already implemented and consist of a fence around the site perimeter and the posting of warning signs which will be maintained during construction, operation, and monitoring of the RRA.

2.2.8 SVE Verification Monitoring

Subsurface soils and groundwater verification monitoring will be performed on a schedule and at locations as described in the revised Exhibit A and as shown on the Drawings.

The monitoring activities will:

- Detect the presence of the VOCs, base neutral/acid organics, PCBs, and heavy metals specified in Table 3-1 (Modified) in the subsurface soils and shallow groundwater during and after vapor extraction; and

- Provide information to determine the effectiveness of the soil vapor extraction program.

Monitoring well construction details are shown on the Drawings. An on-site till monitoring system shall be constructed consisting of four wells screened in the saturated zone of the till. Sampling results from the on-site till wells will be compared to the Acceptable Subsurface Water Concentrations or the Applicable Subsurface Water Background Concentrations ("Applicable Subsurface Water Background Concentrations") on Table 3-1 of revised Exhibit A.

Every time samples are collected from the on-site wells, the soil vapor extraction system will be shut down to allow water, if any, to stabilize within the till. Samples collected from the on-site wells will be analyzed for those parameters listed under Acceptable Subsurface Water Concentrations as contained in Table 3-1 of the revised Exhibit A.

Both unfiltered and filtered subsurface water samples will be collected. Only unfiltered samples will initially be analyzed for VOC's, SVOC's, inorganics, and PCB's. If the results of any unfiltered sample exceeds a cleanup standard for inorganics or PCB's, then the filtered sample will be released for analysis of inorganics and PCB's only. For the purposes of subsequent site characterization, unfiltered samples may be used to assess total risk at a specific location, while only filtered samples may be used to assess fate and transport scenarios and, hence, risk to a distant receptor.

Additionally, the SVE will have a vapor criteria for shutting down individual extraction trenches (or wellpoint laterals) as described in Table 4-1 of the revised Exhibit A. The criteria will be that two consecutive air samples from an individual trench (or wellpoint lateral) show vapor concentrations to be in equilibrium with the acceptable soil concentrations in accordance with the revised Exhibit A.

All wells will be constructed of 2-inch PVC pipe. Screen length will vary for each well. Total depth for the wells completed in the till will be 1 to 2 feet less than total depth to the contact between the till and underlying sand waterbearing zone. Wells completed in the sand and gravel will screen the total thickness of that unit. Wells will have a sand pack to 1 foot above the top of screen and a bentonite grout to the ground surface.

2.3 Operation and Maintenance Requirements

The constructed remedial components, including the SVE system and wastewater storage and treatment systems will be operated and maintained until completion of the remedial action as specified in the Consent Decree.

The wastewater treatment system will be operated as necessary to process accumulated wastewaters. The system will only be operated under constant onsite supervision.

The SVE treatment system will be designed for continuous automatic operation. The operation will be checked once a day during the weekdays (Monday through Friday), and an operator will be on-call at all times during the unmanned operation. System operating vacuums, pressures, flow rates, fluid levels, and instrumentation operations will be checked. Carbon vessels changeouts and either the loading of tanker trucks with collected water for off-site disposal or on-site treatment operations, will also be conducted.

During normal operation, the SVE treatment system will be automatically stopped to facilitate carbon vessel changeout to conduct restart spike tests. Scheduled SVE treatment system maintenance will be conducted during this shutdown. If scheduled maintenance cannot be completed within the time allocation, additional scheduled shutdowns will be required.

Vapor samples from the SVE system will be taken in accordance with the Verification and Compliance Monitoring requirements described in Exhibit A and outlined in the Specifications and the Air Monitoring Plan.

Maintenance on the wastewater treatment and SVE systems will be conducted on a scheduled or an as-required basis. Operation and maintenance requirements will be described in a separate plan to be prepared by the selected Remedial Contractor. The general scope of the Operations and Maintenance Manual is included in the Specifications. Backup power and spare parts and equipment will be provided for all system operations as described in the Specifications.

The RCRA Subtitle C cover will be inspected periodically and repairs will be made as necessary to ensure its integrity (see Section 2.2.6).

2.4 Revised Remedial Action Verification and Compliance Monitoring

The compliance monitoring provisions in Section 4.0 and its subsections thereunder of the revised Exhibit A are applicable to the Revised Remedial Action. Monitoring well construction details are provided in the Technical Specifications and the Drawings. Monitoring sampling and analytical procedures are contained in the Quality Assurance Project Plan.

APPENDIX A

CALCULATIONS

APPENDIX A

CALCULATIONS

CALCULATION NUMBER 1.0

EXCAVATION AMBIENT AIR VOLATILE ORGANIC COMPOUND RISKS (PROVIDED TO U.S. EPA IN A MAY, 1995 SUBMITTAL)

CALCULATION NUMBER 2.0

EXCAVATION AND FILL VOLUMES

CONTAMINATED CONCRETE AND AGGREGATE VOLUMES

	FLOOR SLABS		BUILDING FOOTINGS			VOLUME	
	AREA (square feet)	DEPTH (inches)	LENGTH (feet)	HEIGHT (feet)	WIDTH (inches)	CONCRETE (cu. yds.)	AGGREGATE (cu. yds.)
SOUTH SLAB AREA							
INSIDE SHEET PILE CUTOFF WALL							
Concrete Slab	7,293.0	4.0	----	----	----	90.0	----
Aggregate Subbase	7,293.0	18.0	----	----	----	----	405.2
OUTSIDE SHEET PILE CUTOFF WALL							
Concrete Slab	19,337.0	4.0	----	----	----	238.7	----
Aggregate Subbase	19,337.0	18.0	----	----	----	----	1,074.3
NORTH AREA BUILDINGS							
FLOOR SLAB							
Concrete Slab	3,820.0	4.0	----	----	----	47.2	----
Aggregate Subbase	3,820.0	18.0	----	----	----	----	212.2
BUILDING FOUNDATIONS							
Concrete Frost Wall	----	----	380.0	3.0	8.0	28.1	----
Concrete Footing	----	----	380.0	1.0	24.0	28.1	----
PARKING AREA							
Concrete Slab	5,661.0	4.0	----	----	----	69.9	----
Aggregate Subbase	5,661.0	18.0	----	----	----	----	314.5
TOTAL IN PLACE CONCRETE VOLUME (C.Y.) =						502.1	
TOTAL IN PLACE AGGREGATE VOLUME (C.Y.) =							2,006.2
SWELL FACTOR FOR CRUSHED CONCRETE = 75%						376.6	
TOTAL CRUSHED CONCRETE VOLUME TO BE DISPOSED (C.Y.) =						878.7	
TOTAL AGGREGATE VOLUME TO BE DISPOSED (C.Y.) =							2,006.2
TOTAL VOLUME FOR DISPOSAL IN NORTH FILL AREA (C.Y.) =					**2,884.9**		

CONTAMINATED SOIL EXCAVATION VOLUMES (inside sheet pile wall)

	ELEVATION	SQUARE FEET	AVERAGE SQ. FT.	CONTOUR INTERVAL	CUBIC FEET	CUBIC YARDS	CUMULATIVE CUBIC YARDS
LOWEST POINT OF EXCAVATION	873.5	0.0			0.0	0.0	0.0
			674.3	0.5			
	874.0	1,348.5			337.1	12.5	12.5
			3,375.8	1.0			
	875.0	5,403.0			3,375.8	125.0	137.5
			7,079.4	1.0			
	876.0	8,755.7			7,079.4	262.2	399.7
			8,755.7	2.0			
	878.0	8,755.7			17,511.4	648.6	1,048.3
			8,755.7	2.0			
	880.0	8,755.7			17,511.4	648.6	1,696.9
			8,755.7	2.0			
	882.0	8,755.7			17,511.4	648.6	2,345.4
			8,249.6	1.0			
	883.0	7,743.5			8,249.6	305.5	2,651.0
			6,035.0	1.0			
	884.0	4,326.5			6,035.0	223.5	2,874.5
			2,749.4	1.0			
	885.0	1,172.2			2,749.4	101.8	2,976.3
			598.0	1.0			
	886.0	23.7			598.0	22.1	2,998.5
			11.9	1.0			
HIGHEST POINT OF EXCAVATION	887.0	0.0			11.9	0.4	2,998.9
				TOTAL GROSS EXCAVATION (C.Y.) =			2,998.9
				VOLUME OF CONCRETE PAD (C.Y.) * =			90.0
				VOLUME OF GRAVEL SUBBASE (C.Y.) * =			405.2
				TOTAL NET SOIL EXCAVATION (C.Y.) =			**2,503.7**

* Southern Concrete Pad = 7,293 s.f. @ an average thickness of 4" of concrete and 18" of aggregate subbase.

CONTAMINATED SOIL EXCAVATION VOLUMES (outside sheet pile wall)							
	ELEVATION	SQUARE FEET	AVERAGE SQ. FT.	CONTOUR INTERVAL	CUBIC FEET	CUBIC YARDS	CUMULATIVE CUBIC YARDS
LOWEST POINT OF EXCAVATION	874.0	159.9			0.0	0.0	0.0
			3,595.9	1.0			
	875.0	7,031.8			3,595.9	133.2	133.2
			12,699.9	1.0			
	876.0	18,368.0			12,699.9	470.4	603.5
			20,763.7	1.0			
	877.0	23,159.4			20,763.7	769.0	1,372.6
			23,482.7	1.0			
	878.0	23,806.0			23,482.7	869.7	2,242.3
			24,473.1	2.0			
	880.0	25,140.2			48,946.2	1,812.8	4,055.1
			25,944.6	2.0			
	882.0	26,748.9			51,889.1	1,921.8	5,976.9
			27,083.8	1.0			
	883.0	27,418.6			27,083.8	1,003.1	6,980.0
			24,155.9	1.0			
	884.0	20,893.2			24,155.9	894.7	7,874.7
			14,553.1	1.0			
	885.0	8,213.0			14,553.1	539.0	8,413.7
			4,273.1	1.0			
	886.0	333.1			4,273.1	158.3	8,572.0
			257.6	1.0			
HIGHEST POINT OF EXCAVATION	887.0	182.1			257.6	9.5	8,581.5
				TOTAL GROSS EXCAVATION (C.Y.) =			8,581.5
				VOLUME OF CONCRETE PAD (C.Y.) * =			238.7
				VOLUME OF GRAVEL SUBBASE (C.Y.) * =			1,074.3
				TOTAL NET SOIL EXCAVATION (C.Y.) =			**7,268.5**

* Southern Concrete Pad = 19,337 s.f. @ an average thickness of 4" of concrete and 18" of aggregate subbase.

FILL AREA CONTAMINATED CONCRETE & AGGREGATE VOLUMES

	ELEVATION	SQUARE FEET	AVERAGE SQ. FT.	CONTOUR INTERVAL	CUBIC FEET	CUBIC YARDS	CUMULATIVE CUBIC YARDS
LOWEST POINT OF FILL	886.7	0.0					
			1,111.9	0.3			
	887.0	2,223.7			333.6	12.4	12.4
			7,470.0	1.0			
	888.0	12,716.3			7,470.0	276.7	289.0
			15,547.4	1.0			
	889.0	18,378.5			15,547.4	575.8	864.9
			18,571.6	1.0			
	890.0	18,764.6			18,571.6	687.8	1,552.7
			17,767.4	1.0			
	891.0	16,770.2			17,767.4	658.1	2,210.7
			15,707.6	1.0			
	892.0	14,645.0			15,707.6	581.8	2,792.5
			14,137.8	0.5			
TOP OUTER EDGE OF FILL	892.5	13,630.6			7,068.9	261.8	3,054.3
			11,879.3	0.5			
	893.0	10,127.9			5,939.6	220.0	3,274.3
			7,342.4	1.0			
	894.0	4,556.9			7,342.4	271.9	3,546.2
			2,728.2	1.0			
	895.0	899.4			2,728.2	101.0	3,647.3
			449.7	0.4			
HIGH POINT OF FILL	895.4	0.0			179.9	6.7	3,653.9
	TOTAL GROSS FILL VOLUME FOR CRUSHED CONCRETE & AGGREGATE (C.Y.) =						3,653.9
	FILL VOLUME FOR 12" OF CONTAMINATED SOIL COVER (C.Y.) =						693.9
	TOTAL NET FILL VOLUME FOR CRUSHED CONCRETE & AGGREGATE (C.Y.) =						**2,960.0**
	TOTAL CRUSHED CONCRETE & AGGREGATE FILL REQUIRING DISPOSAL * (C.Y.) =						**2,884.9**

* See spreadsheet titled "CONTAMINATED CONCRETE AND AGGREGATE VOLUMES"

FILL AREA CONTAMINATED SOIL VOLUMES

	ELEVATION	SQUARE FEET	AVERAGE SQUARE FEET	CONTOUR INTERVAL	CUBIC FEET	CUBIC YARDS	CUMULATIVE CUBIC YARDS
LOWEST POINT OF FILL	886.7	0.0					
			1,111.9	0.3			
	887.0	2,223.7			333.6	12.4	12.4
			10,974.6	1.0			
	888.0	19,725.4			10,974.6	406.5	418.8
			32,970.5	1.0			
	889.0	46,215.5			32,970.5	1,221.1	1,639.9
			52,898.9	1.0			
	890.0	59,582.3			52,898.9	1,959.2	3,599.2
			61,112.2	1.0			
	891.0	62,642.0			61,112.2	2,263.4	5,862.6
			60,863.5	1.0			
	892.0	59,085.0			60,863.5	2,254.2	8,116.8
			58,214.3	0.5			
TOP OUTER EDGE OF FILL	892.5	57,343.6			29,107.2	1,078.0	9,194.8
			52,006.2	0.5			
	893.0	46,668.7			26,003.1	963.1	10,157.9
			37,572.7	1.0			
	894.0	28,476.7			37,572.7	1,391.6	11,549.5
			21,473.3	1.0			
	895.0	14,469.8			21,473.3	795.3	12,344.8
			9,568.8	1.0			
	896.0	4,667.7			9,568.8	354.4	12,699.2
			2,333.9	0.9			
HIGH POINT OF FILL	896.9	0.0			2,100.5	77.8	12,777.0
TOTAL DISPOSAL VOLUME AVAILABLE FOR CONTAMINATED MATERIALS (C.Y.) =							12,777.0
TOTAL DISPOSAL VOLUME SET ASIDE FOR CONTAMINATED CONCRETE AND AGGREGATE (C.Y.) =							2,960.0
NET DISPOSAL VOLUME FOR CONTAMINATED SOILS (C.Y.) =							**9,816.9**

CALCULATION NUMBER 3.0

EXCAVATION STABILITY

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ENVIRO-CHEM	FILE NO.: 2455.001	BY: M. DOWIAK	PAGE 1 OF 5
SUBJECT: PRELIMINARY DESIGN		CHECKED BY:	DATE: 12/28/94

3.0 EXCAVATION STABILITY EVALUATION

3.1 PROBLEM DEFINITION:

EVALUATE THE STABILITY OF THE PROPOSED SOIL EXCAVATION IN THE AREA OF THE SOUTHERN CONCRETE PAD.

EXCAVATION DEPTH = 9' BELOW TOP OF CONCRETE
EXCAVATION FLOOR AREA IS PROJECTED VERTICALLY DOWNWARD FROM REMEDIAL BOUNDARY ON EAST, WEST SOUTH SIDES, AND FROM EDGE OF CONCRETE PAD ON NORTH SIDE (SEE FIGURES C-1, C-2)
FLOOR AREA ~ 205 X 160 FT ~ 32,800 SF

SITE CONDITIONS: REFERENCE CONCRETE PAD AREA SITE INVESTIGATION REPORT, AWD, 1/95

3.2 APPROACH

CONSIDER TWO EVALUATION METHODS:

1. HYDROSTATIC UPLIFT FAILURE BECAUSE OF POTENTIOMETRIC PRESSURE IN UNDERLYING SAND WATER-BEARING ZONE

   ASSUMPTIONS:

   1.1 SEEPAGE FORCES IN TILL FROM UPWARD LEAKAGE OF SAND WATER-BEARING ZONE ARE NEGLIGIBLE BECAUSE OF LOW PERMEABILITY
   1.2 SIDE SHEAR STRENGTH NEGLECTED $(CL + \sigma \tan\phi)$
   1.3 FLEXURAL (TENSILE) STRENGTH OF EXCAVATION FLOOR CONSIDERED FOR NARROW FLOOR LENGTHS, L_1

2. SHEAR FAILURE BY STRESS RELIEF IN EXCAVATION

   ASSUMPTIONS:

   2.1 FOUNDATION LOADING PROBLEM.
   2.2 CLAY TILL UNDRAINED SHEAR STRENGTH USED, $S_u = \frac{\sigma}{2}$

AWD TECHNOLOGIES

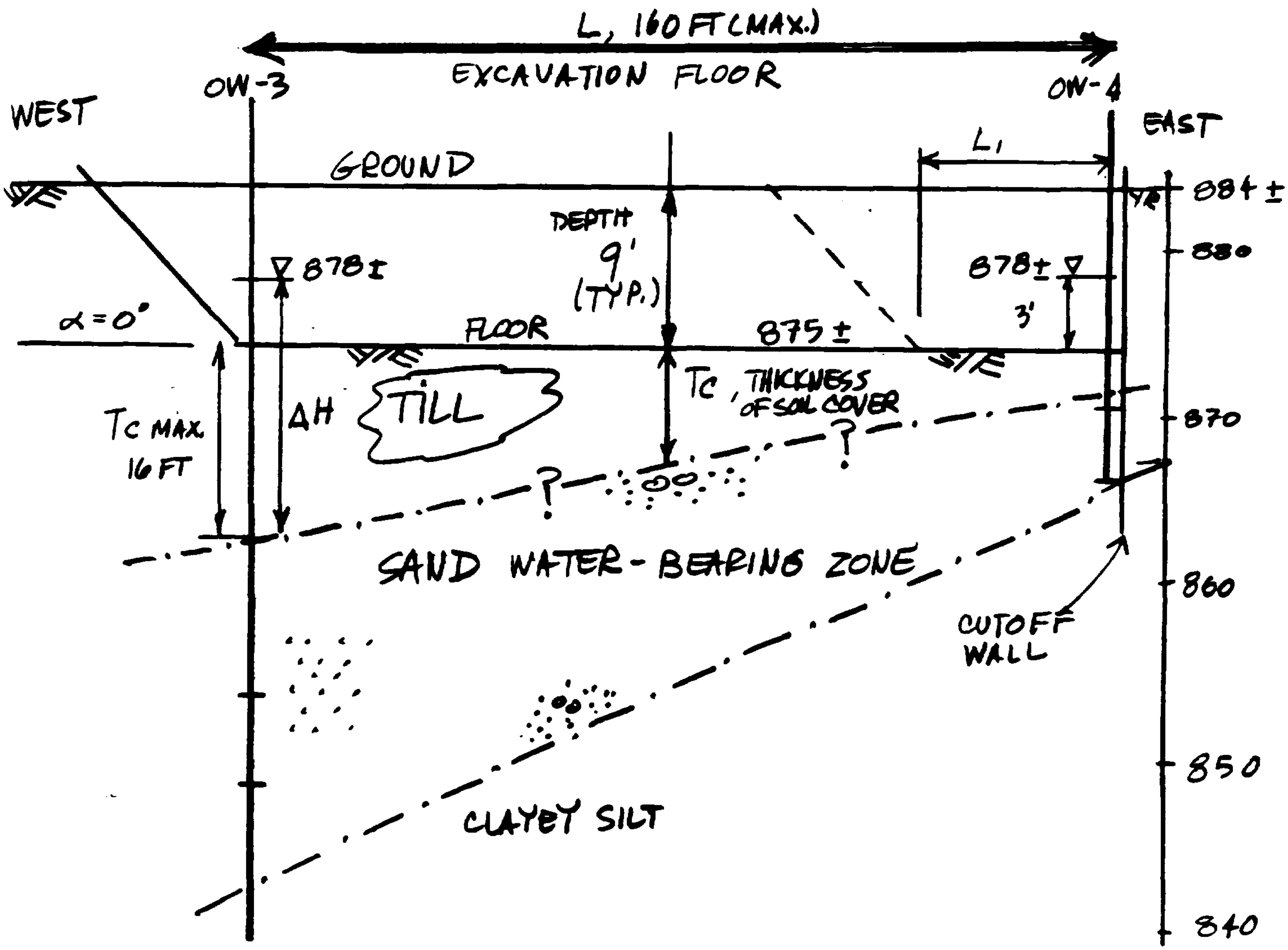
CALCULATION WORKSHEET

CLIENT: ECC	FILE NO.: 2455.001	BY: M. DOWIAK	PAGE 2 OF 5
SUBJECT:		CHECKED BY:	DATE: 12/28/94

3.3 HYDROSTATIC UPLIFT EVALUATION

REFERENCES:

1. BOWLES, J.E., PHYSICAL AND GEOTECHNICAL PROPERTIES OF SOILS, McGRAW HILL, 1984
2. OAKLEY, R.E., DESIGN AND PERFORMANCE OF EARTH-LINED CONTAINMENT SYSTEMS, IN GEOTECHNICAL PRACTICE FOR WASTE DISPOSAL 1987, ASCE GEOTECHNICAL SPECIAL PUBLICATION NO 13, 1987



AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ECC	FILE NO.: 2455.001	BY: M. DOWIAK	PAGE 3 OF 5
SUBJECT:		CHECKED BY:	DATE: 12/29/94

3.3 CONT

FACTOR OF SAFETY (FS) AGAINST HYDROSTATIC UPLIFT:

$$FS = \frac{\gamma_s T_c}{\gamma_w (\Delta H)} + \frac{2(T_c^2)\sigma_s}{\gamma_w (\Delta H) L^2}$$

$\left(\underset{\text{RESISTANCE}}{\overset{FS_u}{\text{UPLIFT}}} + \underset{\text{RESISTANCE}}{\overset{FS_B}{\text{BENDING}}} \right)$

WHERE γ_s, UNIT WEIGHT OF SOIL COVER, 145 PCF (ATTACH NO 3.1)
T_c, THICKNESS OF SOIL COVER, FT
γ_w, UNIT WEIGHT WATER, 62.4 PCF
L, LENGTH OF EXCAVATION (AT BOTTOM) $L_1 < L$
ΔH, HYDROSTATIC HEAD, FT.
σ_s, SOIL TENSILE STRENGTH, PSF
USE 432 PSF (SEE ATTACHMENT 3.2).

T_c, FT	ΔH, FT	L OR L_1, FT.	FS_U	FS_B	FS TOTAL	
2.0 (MIN.)	5	160 (MAX).	0.93	4×10^{-4}	0.93	NO
2.0	5	20	0.93	0.03	0.96	NO
2.0	5	10 (MIN)	0.93	0.11	1.04	NO
12.0 (MAX)	15	160 (MAX)	1.86	5×10^{-2}	1.86	OK
12.0	15	10 (MIN)	1.86	1.33	3.19	OK
12.0	15	20	1.86	0.33	2.19	OK

DETERMINE MIN. T_c AT FS = 1.3, L = VARIES
TRIAL & ERROR:

6.0	9	20	1.55	0.14	1.69	OK
5.0	8	20	1.45	0.11	1.56	OK
4.0	7	20	1.33	0.08	1.41	OK
3.0	6	20	1.16	0.05	1.21	NO
2.0	2 (A)	20	2.32	0.07	2.39	OK
5.0	8	100	1.45	0.004	1.45	OK

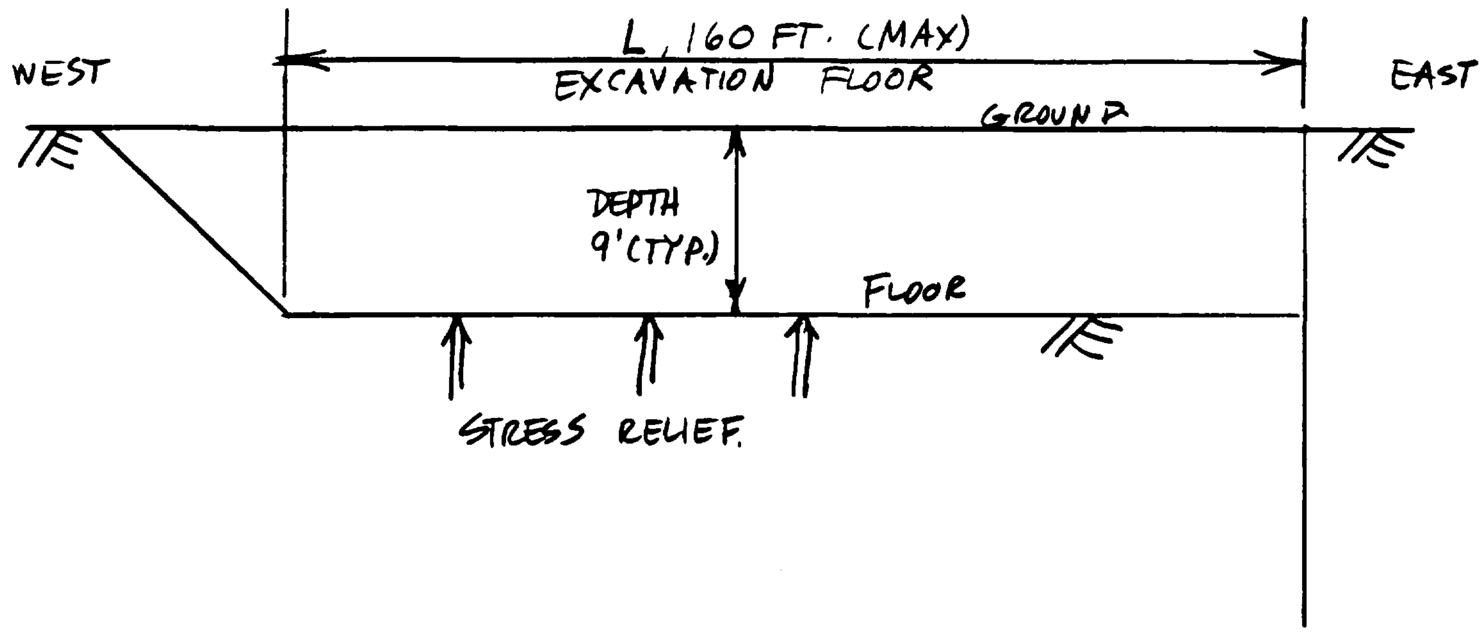
NOTE A - DEWATERING TO REDUCE ΔH TO TOP OF FLOOR

USE T_c = 4.0 FT MIN. WITHOUT CUTOFF WALLS
FOR T_c < 4.0 FT, USE CUTOFF WALLS IN SAND.

3.4 SHEAR FAILURE EVALUATION

REFERENCES:

1. LAMBE AND WHITMAN, SOIL MECHANICS, SEC. 32.3, JOHN WILEY & SONS, 1969.



FACTOR OF SAFETY AGAINST SHEAR FAILURE:

$$FS = \frac{N_c S_u}{\Delta \sigma_v}$$

WHERE N_C, BEARING CAPACITY FACTORS, ATTACHMENT 3.3, FIG. 32.4)

S_u, UNDRAINED SHEAR STRENGTH OF TILL = $0.5\, \sigma_p$, WHERE σ_p IS THE PEAK SHEAR STRENGTH FROM UNCONSOLIDATED-UNDRAINED TRIAXIAL TEST (ATTACHMENT 3.4)

$\Delta \sigma_v$, STRESS RELIEF AT BOTTOM OF EXCAVATION = DEPTH (9 FT) × γ_s (145 PCF), NO SURCHARGE

SW-3 TILL SAMPLE

ATTACHMENT 3.1 1/2

Geotechnics

SHELBY TUBE UNIT WEIGHT

Client	AWD	Tested By	JCM 12-8-94
Client Project	ENVIRO CHEM	Checked By	KKe 12-19-94
Project No.	94359		
Boring No.	CP-1	Tube Recovery	2
Depth Pushed	12.0-14.0		
Shelby Tube No.	NA		

SOIL PROFILE AND SAMPLING

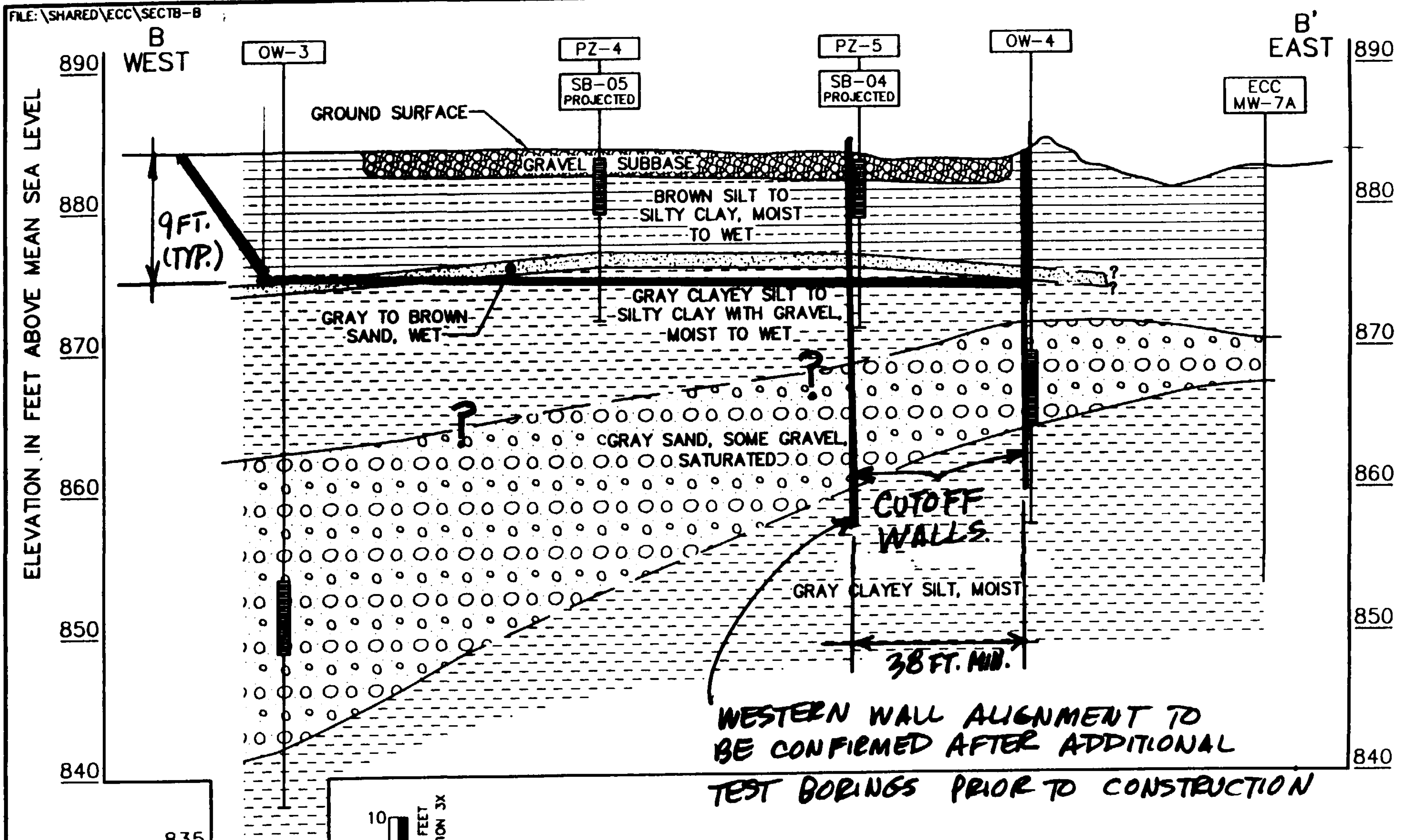
DEPTH ( )	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
12.00					
12.50					
13.00					
13.50		2		GRAY SANDY LEAN CLAY	UU GRAINSIZE HYDROMETER LIMITS,UNIT WGT
14.00		1			WC

NOTE:WHEN FULL RECOVERY IS NOT ACHIEVED,SOIL ELEVATION CAN NOT BE ACCURATELY DEFINE
INDICATE EACH CUT OF THE TUBE WITH AN ARROW
INDICATE DIVIDING LINE BETWEEN SOIL TYPES BY A SOLID LINE
INDICATE WAX BY CROSS-HATCHING
INDICATE SOIL TYPES BY STANDARD SYMBOLS

MOISTURE CONTENT					
Section Number	1	2	3	4	5
Tare Number	1385				
Wt. Tare & WS(gm.)	241.87				
Wt. Tare & DS(gm.)	223.41				
Wt. Tare(gm.)	39.43				
Moisture Content(%)	10.0				

UNIT WEIGHT	
Wt. Tube & WS.(gms.)	1906.50
Wt. Of Tube(gms.)	421.00
Wt. Of WS.(gms.)	1485.50
Length 1 (in.)	6.020
Length 2 (in.)	6.003
Length 3 (in.)	6.010
Top Diameter (in.)	2.880
Middle Diameter (in.)	2.882
Bottom Diameter (in.)	2.866
Sample Volume (cc)	639.91
Moisture Content(%)	10.03
Unit Wet Wt.(gms/cc)	2.32
Unit Wet Wt.(pcf.)	144.9
Unit Dry Wt.(pcf.)	131.6
Unit Dry Wt.(gms/cc)	2.11

EXCAVATION PROFILE



AWD TECHNOLOGIES, INC

CONCRETE PAD AREA INVESTIGATION
CROSS SECTION B-B'

ENVIRO-CHEM SUPERFUND SITE	ZIONSVILLE, IN
CLIENT: ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION TRUST	JOB NUMBER: 2455-004
SCALE: AS SHOWN	FIGURE NUMBER C-2 · REV 0

OW-5 TILL SAMPLE

ATTACHMENT 3.1

geotechnics

SHELBY TUBE UNIT WEIGHT

Client	AWD	Tested By	JCM 12-8-94
Client Project	ENVIRO CHEM	Checked By	[signature] 12-19-94
Project No.	94359		
Boring No.	CP-2	Tube Recovery	2
Depth Pushed	12.0-14.0		
Shelby Tube No.	NA		

SOIL PROFILE AND SAMPLING

DEPTH ( )	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
12.00					
12.50					
13.00					
13.50		2		GRAY SANDY SILTY CLAY	UU GRAINSIZE HYDROMETER LIMITS,UNIT WGT
14.00		1			WC.

NOTE:WHEN FULL RECOVERY IS NOT ACHIEVED,SOIL ELEVATION CAN NOT BE ACCURATELY DEFINE
INDICATE EACH CUT OF THE TUBE WITH AN ARROW
INDICATE DIVIDING LINE BETWEEN SOIL TYPES BY A SOLID LINE
INDICATE WAX BY CROSS-HATCHING
INDICATE SOIL TYPES BY STANDARD SYMBOLS

MOISTURE CONTENT					
Section Number	1	2	3	4	5
Tare Number	11170				
Wt. Tare & WS(gm.)	296.14				
Wt. Tare & DS(gm.)	277.85				
Wt. Tare(gm.)	94.07				
Moisture Content(%)	10.0				

UNIT WEIGHT		
Wt. Tube & WS.(gms.)		1947.70
Wt. Of Tube(gms.)		425.00
Wt. Of WS.(gms.)		1522.70
Length 1 (in.)		6.040
Length 2 (in.)		6.057
Length 3 (in.)		6.040
Top Diameter (in.)		2.876
Middle Diameter (in.)		2.880
Bottom Diameter (in.)		2.871
Sample Volume (cc)		643.45
Moisture Content(%)		9.95
Unit Wet Wt.(gms/cc)		2.37
Unit Wet Wt.(pcf.)		147.7
Unit Dry Wt.(pcf.)		134.3
Unit Dry Wt.(gms/cc)		2.15

ATTACHMENT 3.2

REF: FANG, H.Y. VAN NOSTRAND, 1991

The values of A and B can be measured experimentally in both laboratory and field. (For more discussion, see Lambe (1962) and Lambe and Whitman (1979)).

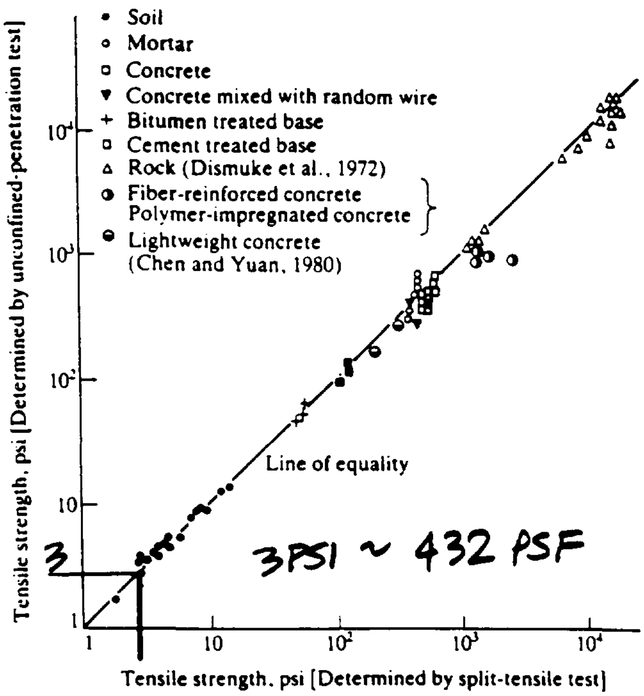
3.13.3 Sensitivity

Most clays lose a portion of their strength and stiffness when remolded. The main cause of this phenomenon may be reorientation of particles into less favorable positions. If the clay regains a portion of its strength with elapsed time, the phenomenon is referred to as *thixotropy*.

The sensitivity of a soil to remolding is measured by the ratio of undisturbed strength to remolded strength as defined by Terzaghi (1944). Commonly, the unconfined compression test is used. From the point of view of their sensitivity to remolding, clays may conveniently be classified as follows (Skempton and Northey, 1952; Bjerrum, 1954):

Sensitivity	*Classification*
<2	insensitive
2–4	moderately sensitive
4–8	sensitive
8–16	very sensitive
16–32	slightly quick
32–64	medium quick
>64	quick

The sensitivity of most clays ranges from 2 to 4, that of peat from 1.5 to 10, and of marine clays from 1.6 to 26.



*

Fig. 3.31 Comparison of tensile strength of various construction materials determined by unconfined-penetration and split-tensile tests. [1 psi = 6.9 kPa (kN/m^2).]

3.13.4 Tensile Strength

Tensile strength data are useful for predicting the cracking behavior of earth dams, highway pavement, and stabilized soil structures. For its determination, a simple test method called the double-punch test or unconfined-penetration (UP) test may be used (Fang and Chen, 1971; Fang and Fernandez, 1981). This test uses two steel disks centered on both top and bottom surfaces of a cylindrical soil specimen; load is then applied on the disks until the specimen reaches failure. The tensile strength is computed by the following formula:

$$\sigma_t = \frac{P}{\pi(KbH - a^2)} \tag{3.49}$$

in which

σ_t = tensile strength
P = load
b = radius of the specimen
a = radius of disk
H = height of specimen
K = constant = 1.0

A height–diameter ratio of the specimen varying from 0.8 to 1.2 and a ratio of the diameter of the specimen to the diameter of the disk varying from 0.2 to 0.3 are suitable for the test.

Comparison of tensile strength of various construction materials determined by both UP test (Eq. 3.49) and the conventional split-tension test are presented in Figure 3.31. Good agreement between both tensile strength results has been observed. The UP test has the advantage that the test can be conveniently performed in conjunction with routine California Bearing Ratio (CBR) and compaction tests. The split-tension test and other tensile strength test methods measure the tensile strength across a predetermined failure plane, whereas the UP test always causes failure on the weakest plane, which results in the measurement of the true tensile strength.

3.13.5 Residual Shear Strength

For analysis of shear characteristics of overconsolidated clays, ordinary shear tests are not suitable because they give too high a shear value. Skempton (1964) showed that the strength remaining in laboratory samples after large shearing displacement corresponded closely with the computed strength from actual landslides (Chapters 10 and 11); therefore, he proposed a residual strength concept as shown in Figure 3.32 and Equation 3.50:

$$S_r = \sigma' \tan\phi \tag{3.50}$$

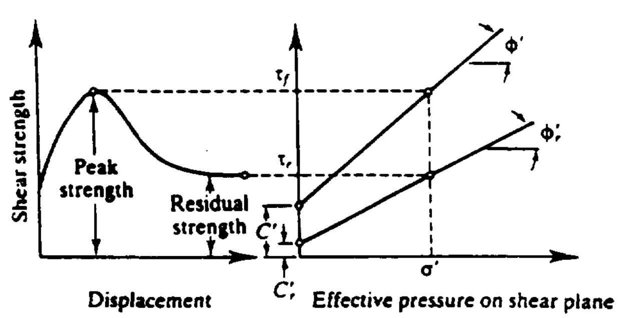


Fig. 3.32 Residual shear strength.

AWD TECHNOLOGIES

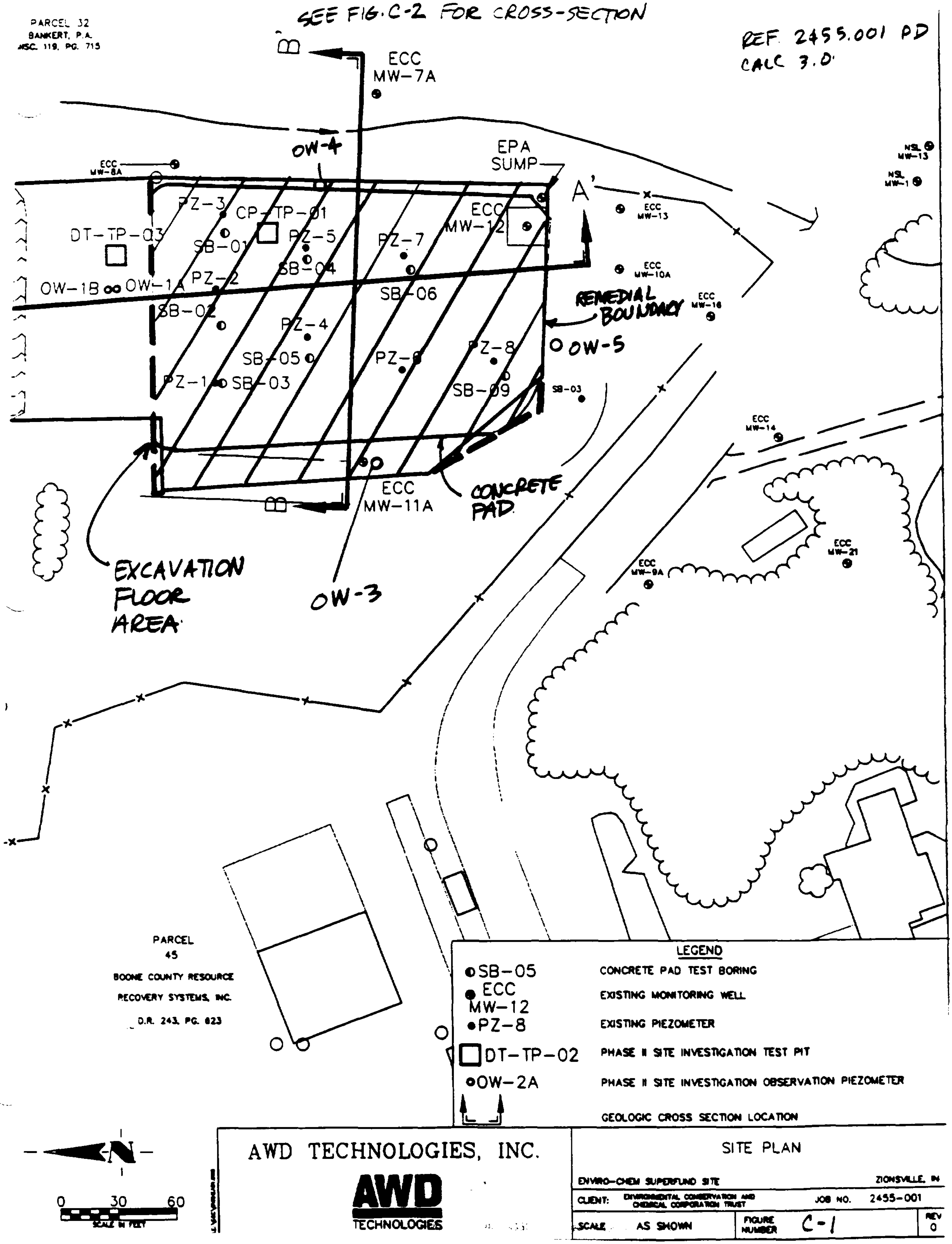
CALCULATION WORKSHEET

CLIENT: ECC	FILE NO.: 2455.001	BY: M. Dowiak	PAGE 5 OF 5
SUBJECT:		CHECKED BY:	DATE: 12/29/94

D, FT	L, FT (B IN FIG. 32.4)	N_c (FIG. 32.4)	S_u, PSF	σ_v, PSF	FS	
9	160	6.2	2880	1305	13.68	OK
9	10	5.8	2880	1305	12.80	OK
5	10	5.5	2880	725	21.80	OK

3.5 CONCLUSIONS

1. FOR OPEN EXCAVATIONS WITHOUT A CUTOFF WALL IN THE SAND WATER-BEARING ZONE, A MINIMUM 4.0 FT THICK SOIL COVER IS NECESSARY BETWEEN THE EXCAVATON FLOOR AND THE TOP OF THE SAND WATER-BEARING ZONE TO PREVENT EXCAVATION BOTTOM UPLIFT
2. ALL OPEN EXCAVATIONS WITH LESS THAN 4.0 FEET THICK SOIL COVER WILL REQUIRE A CUTOFF WALL INTO THE SAND WATER-BEARING ZONE WITH INTERNAL DEWATERING TO REDUCE THE HYDROSTATIC HEAD ELEVATION TO THE ELEVATION OF THE EXCAVATION FLOOR
3. ADDITIONAL SITE INVESTIGATIONS WILL BE REQUIRED TO DETERMINE THE DEPTH OF THE SAND WATER-BEARING ZONE IN THE CENTER AREA OF THE CONCRETE PAD AND TO CONFIRM THE WESTERN ALIGNMENT OF THE CUTOFF WALL



SEE FIG. C-2 FOR CROSS-SECTION
REF 2455.001 PD
CALC 3.0'
PARCEL 32
BANKERT, P.A.
MSC. 119, PG. 715
ECC
MW-7A
OW-4
EPA
SUMP
A'
ECC
MW-8A
PZ-3
CP-TP-01
DT-TP-03
SB-01
PZ-5
PZ-7
ECC
MW-12
ECC
MW-13
NSL
MW-13
NSL
MW-1
SB-04
OW-1B
OW-1A
PZ-2
SB-06
ECC
MW-10A
SB-02
REMEDIAL BOUNDARY
ECC
MW-16
PZ-4
OW-5
SB-05
PZ-6
PZ-8
PZ-1
SB-03
SB-09
SB-03
ECC
MW-14
ECC
MW-11A
CONCRETE PAD
EXCAVATION FLOOR AREA
OW-3
ECC
MW-9A
ECC
MW-21
PARCEL
45
BOONE COUNTY RESOURCE
RECOVERY SYSTEMS, INC.
D.R. 243, PG. 623
LEGEND
SB-05 CONCRETE PAD TEST BORING
ECC MW-12 EXISTING MONITORING WELL
PZ-8 EXISTING PIEZOMETER
DT-TP-02 PHASE II SITE INVESTIGATION TEST PIT
OW-2A PHASE II SITE INVESTIGATION OBSERVATION PIEZOMETER
GEOLOGIC CROSS SECTION LOCATION
N
0 30 60
SCALE IN FEET
AWD TECHNOLOGIES, INC.
AWD
TECHNOLOGIES
SITE PLAN
ENVIRO-CHEM SUPERFUND SITE
ZIONSVILLE, IN
CLIENT: ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION TRUST
JOB NO. 2455-001
SCALE AS SHOWN
FIGURE NUMBER C-1
REV 0

OW-3 TILL SAMPLE

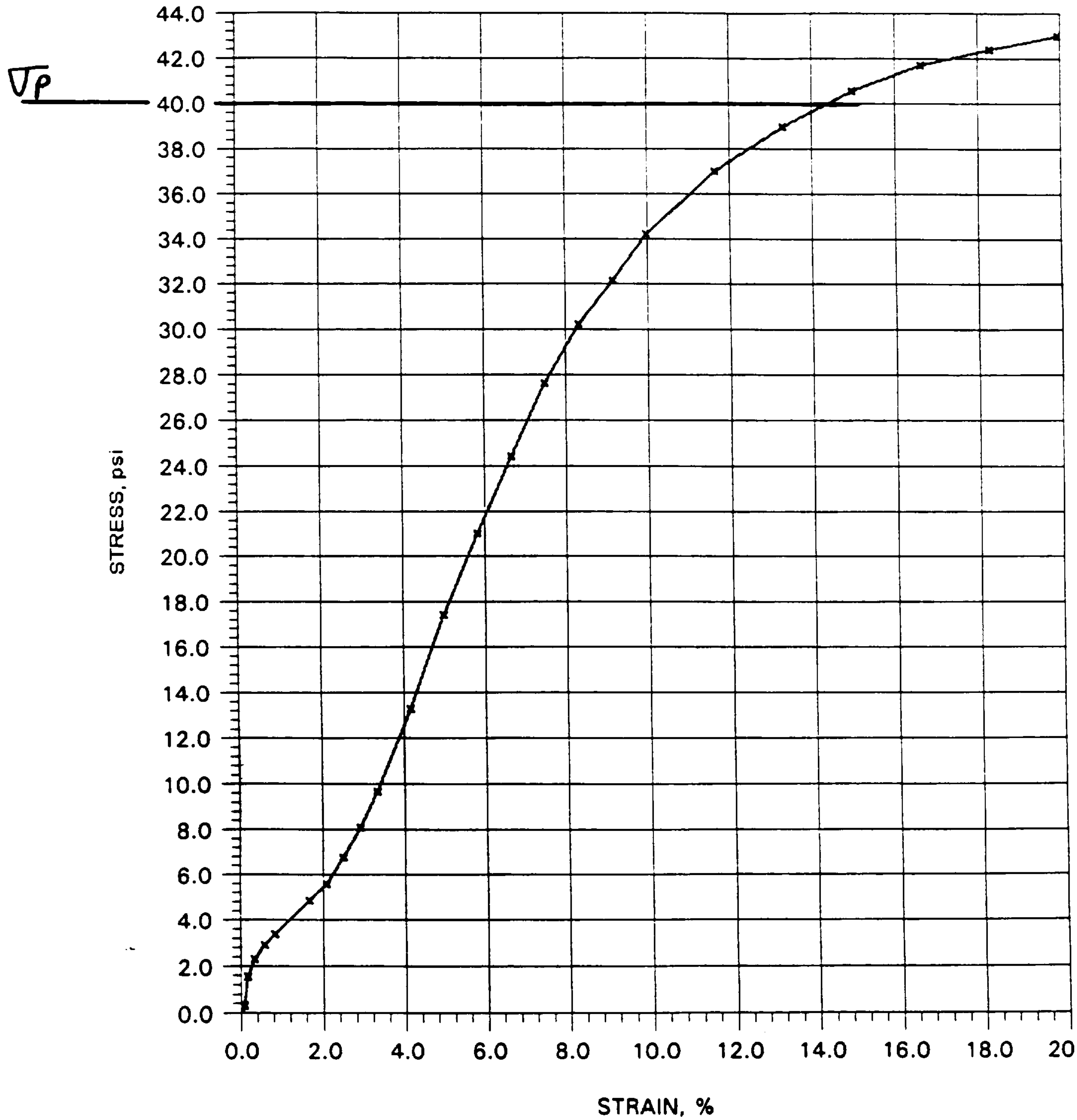
geotechnics

UNCONSOLIDATED UNDRAINED TRIAXIAL

ATTACHMENT 3.4 1/2

Client	AWD	Boring No.	CP-1
Client No.	ENVIRO CHEM	Depth (ft.)	13.3-13.8
Project No.	94359	Sample No.	NA
Visual Description	GRAY CLAY SOME SAND		

CONFINING STRESS, psi 11.3



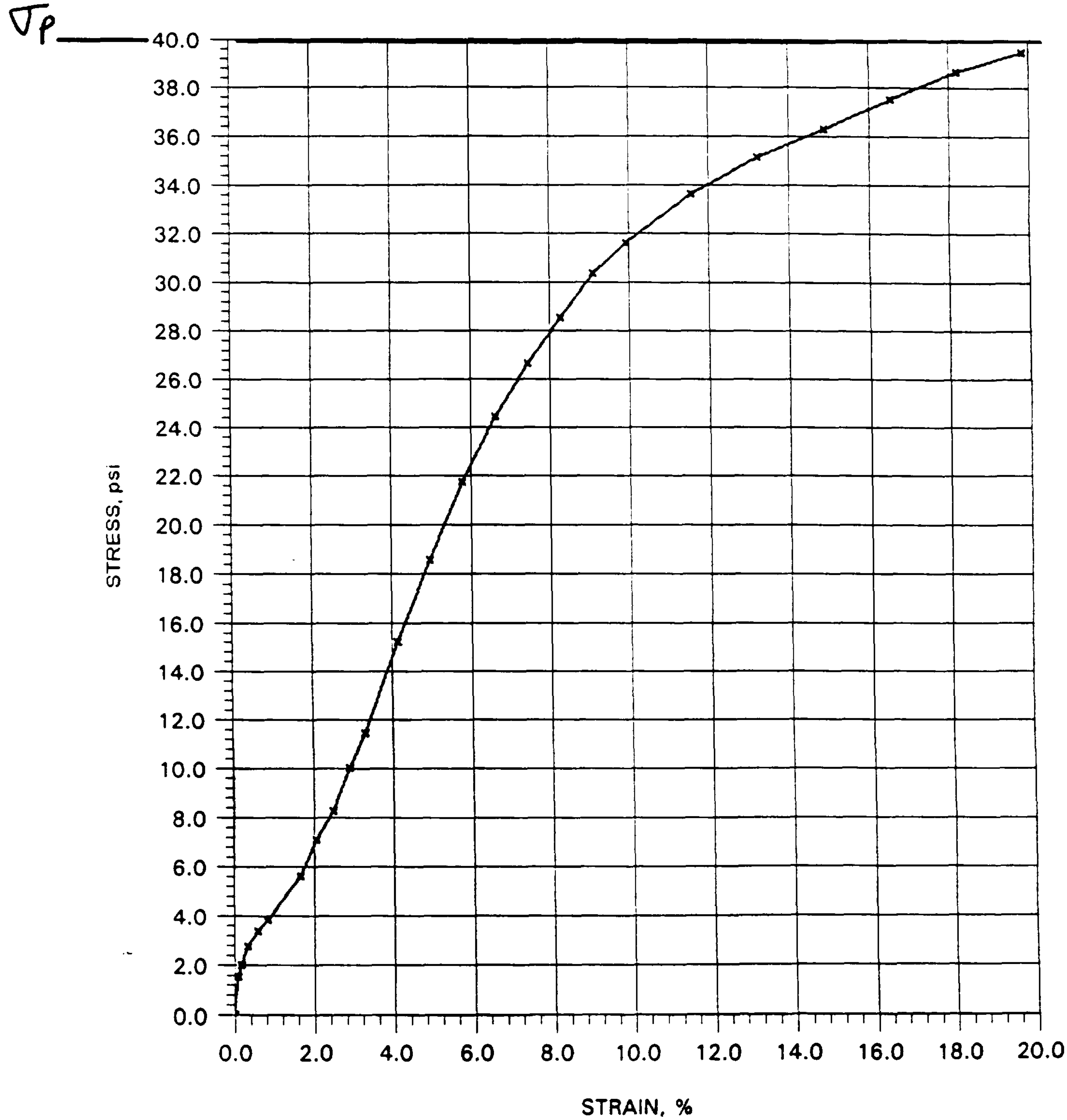
OW-5 TILL SAMPLE

geotechnics

UNCONSOLIDATED UNDRAINED TRIAXIAL

ATTACHMENT 3.4 2/2

Client	AWD	Boring No.	CP-2
Client No.	ENVIRO CHEM	Depth (ft.)	13.3-13.8
Project No.	94359	Sample No.	NA
Visual Description	GRAY SILTY CLAY		
		CONFINING STRESS, psi	11.3



P.O. Box 10623 • Pittsburgh, PA 15235 • Phone (412) 243-0333 • Fax (412) 243-7850

CALCULATION NUMBER 4.0

DEWATERING VOLUMES

AWD TECHNOLOGIES

APPENDIX C

CALCULATION WORKSHEET

CLIENT: ECC TRUST	FILE NO.: 2075.001	BY: JGK	PAGE 1 OF 6
SUBJECT: Dewatering CALCULATION		CHECKED BY:	DATE: February 25 94

4.1 Dewatering Volume Estimates

ASSIGNMENT: Review Dewatering calculations prepared by AWD during PHASE II Supplemental Investigation (MARCH 93). Make comments and changes as appropriate given available site data.

The volume of water in storage was found to provide a reasonable approximation based upon known site conditions.

Volume of WATER = SURFACE AREA (ft^2) x SATURATED Thickness (ft) x effective Porosity

$$V = A\, b\, (n)$$

FOR AREA A (NORTH) SEE FIGURE C-4.1

SURFACE AREA (A) = 83424 ft^2

SAT. Thickness (b) = 4 feet

effective porosity (n) = 0.10

$V_{AREA\ A}$ = 83424 ft^2 x 4 feet x 0.10

V_A = 33,370 ft^3

$V_A \approx$ 250,000 GAllons

FOR AREA B (CENTRAL)

V_B = 18600 ft^2 x 4 feet x 0.10

V_B = 7440 ft^3

$V_B \approx$ 56,000 GAllons

FOR AREA C (SOUTHERN PAD)

V_c = 31,318 ft^2 x 1.5 (GRAVEL) x 0.30 + 31,318 ft^2 x 6.0' (Soil) x 0.10

= 14,093 ft^3 + 18,791 ft^3

$\approx$ 105,000 GAllons + 140,000 GAllons

$\approx$ 245,000 GALLONS

The Dewatering equations were reviewed and a minor modification has been applied. Based upon the relatively limited hydrogeologic data, a range of discharge values is recommended. The values being provided represent a conservative estimate.

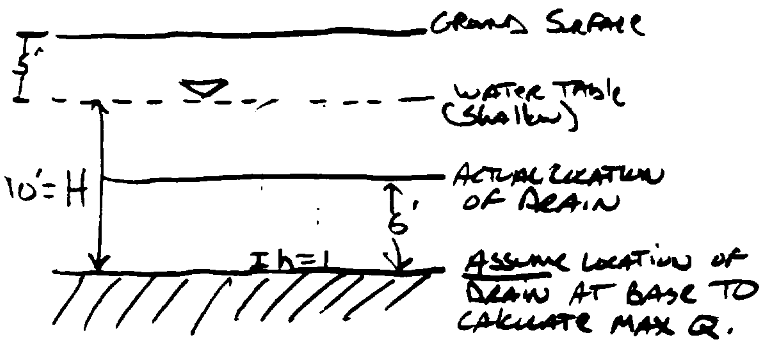
CALCULATION WORKSHEET

CLIENT	FILE NO.	BY	PAGE
ECC TRUST	2455.001	JSK	2 OF 6
SUBJECT: DEWATERING CALCULATION REVIEW		CHECKED BY	DATE 5/12/94

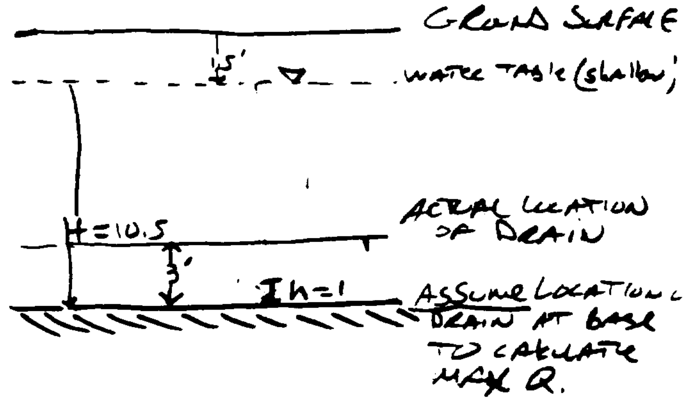
THE MODIFICATION PROPOSED IS TO CALCULATE Q FOR THE DRAIN FOR TWO SCENARIOS:

(1) • ASSUME THE DRAIN FULLY PENETRATES THE SHALLOW WATER BEARING ZONE DOWN TO A DEPTH OF 3 FEET ABOVE THE DEEPER SAND AND GRAVEL AQUIFER. THIS VALUE SHOULD REPRESENT A MAXIMUM Q VALUE FOR THE SHALLOW WATER BEARING ZONE. THIS CALCULATION <u>DOES NOT</u> ASSUME THAT VERTICAL LEAKAGE FROM THE UNDERLYING SAND AND GRAVEL AQUIFER IS OCCURRING IN AREAS A AND B. FOR AREA C VERTICAL FLOW FROM UNDERLYING SAND AND GRAVEL IS CONSIDERED AS CALCULATED BY AWD (3/93)

AREA A AND B



AREA C



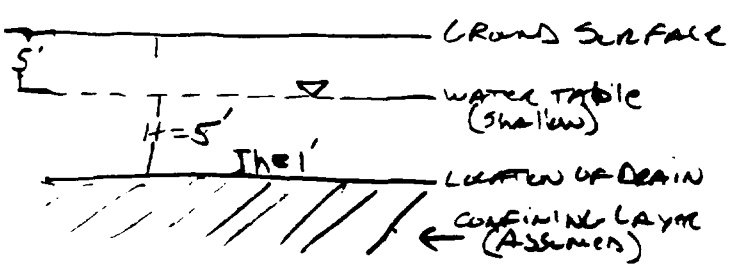
(2) • ASSUME THAT THE ACTUAL BASE OF DRAIN EXTENDS TO THE BASE OF THE SHALLOW WATER BEARING ZONE AND THAT GROUNDWATER FLOW BENEATH 9' IN AREAS A+B IS INSIGNIFICANT. FOR AREA C VERTICAL FLOW FROM THE UNDERLYING SAND AND GRAVEL IS CONSIDERED AS CALCULATED BY AWD (3/93).

WD TECHNOLOGIES

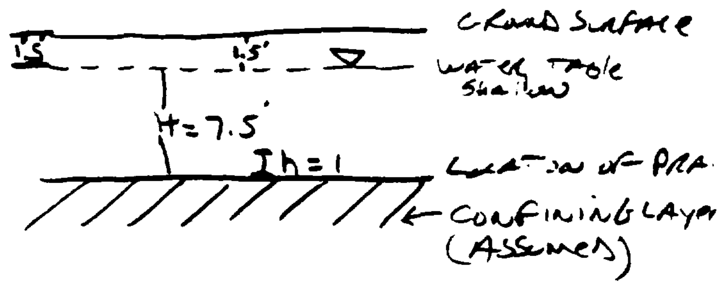
CALCULATION WORKSHEET

CLIENT: ECCTRUST	FILE NO. 2455.001	BY: JGK	PAGE 3 OF 6
SUBJECT: DEWATERING CALCULATION REVISION		CHECKED BY:	DATE 5/ /94

AREA A AND B



AREA C



The FORMULA UTILIZED will be that which WAS ORIGINALLY USED FOR MARCH 93 CALCULATIONS (SEE ORIGINAL CALCULATIONS FOR ACTUAL PARAMETERS)

$$Q = \frac{K(H^2 - h^2)\ x}{2880\ L_o}$$

= Flow per UNIT Length per one side of Trench ASSUMING UNCONFINED CONDITIONS

Q = Flow RATE (GPM)

H = SATURATED Thickness of WATER BEARING ZONE, IN FT

h = distance FROM BOTTOM OF SATURATED ZONE TO WATER level IN Trench during dewatering, IN FT.

L_o = radius of influence (Ft.)

x = UNIT length OF TRENCH (Ft.)

K = hydraulic CONDUCTIVITY (GPD/Ft^2)

$$L_o = 3(H-h)\sqrt{K}\text{(IN m/sec)}$$

WD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ECC TRUST	FILE NO.: 2455.001	BY: JGK	PAGE 4 OF 6
SUBJECT: Dewatering Calculation Re ...		CHECKED BY:	DATE: 5/ /...

For Area A, Scenario #1:

$$L_o = 3(10-1)\sqrt{0.1\,in/sec}$$
$$L_o = 8.5\ feet$$

$$Q_A = \frac{(0.21\,GPD/ft^2)\left[10ft^2 - 1ft^2\right]\,1040\,ft}{2880\,(8.5\,ft)}$$

$$Q_A = 0.88\ GPM$$

For Area A, Scenario #2:

$$L_o = 3(5-1)\sqrt{0.1\,in/sec}$$
$$L_o = 380\,ft.$$

$$Q_A = \frac{(0.21\,GPD/ft^2)\left[5ft^2 - 1ft^2\right]\,1040}{2880\ \ 3.80\,ft}$$

$$Q_A = 0.48\ GPM$$

Q_A RANGE = 0.48 GPM to 0.88 GPM

CALCULATION WORKSHEET

CLIENT	FILE NO.	BY	PAGE
ECC TRUST	2455.001	TJK	5 of 6
SUBJECT		CHECKED BY	DATE
[illegible]			5/[illegible]

FOR AREA B, SCENARIO #1:

$L_O = 8.5$ (SAME AS AREA A)

$$Q_B = \frac{(0.21\,GPD/ft^2)[10ft^2 - 1ft^2](308ft)}{2880\,(8.5)}$$

$Q_B = 0.26$ GPM

FOR AREA B, SCENARIO #2:

$L_O = 3.8$ ft (SAME AS AREA A)

$$Q_B = \frac{(0.21\,GPD/ft^2)[5ft^2 - 1ft^2](308ft)}{2880\,(3.8ft)}$$

$Q_B = 0.14$ GPM

Q_B RANGE = 0.14 to 0.26 GPM

FOR AREA C, SCENARIO #1

K IN AREA C = 2.1 GPD/ft^2 OR 1 in/sec (AWD, 3/93)

$L_O = 3(10.5 - 1)\sqrt{1.0}$

$L_O = 28.5$ FEET

$$Q_{C_1} = \frac{(2.1\,GPD/ft^2)[105ft^2 - 1ft^2](584\,FEET)}{2880\,(28.5ft)}$$

$Q_{C_1} = 1.63$ GPM

CALCULATION WORKSHEET

CLIENT	FILE NO.	BY	PAGE
ECC TRUST	2455.001	J[illegible]	6 OF 6
SUBJECT: DEWATERING CALCULATION [illegible]		CHECKED BY:	DATE: [illegible]

FOR AREA C, SCENARIO #2

$L_o = 3(7.5-1)\sqrt{1}$

$L_o = 14.5 \text{ ft}$

$$Q_{C_2} = \frac{(2.16 \text{ PP/ft}^2)\,[7.5 \text{ ft}^2 - 1 \text{ ft}^2]\,(584 \text{ ft})}{2880\ (14.5 \text{ ft})}$$

$Q_{C_2} = \underline{1.21 \text{ GPM}}$

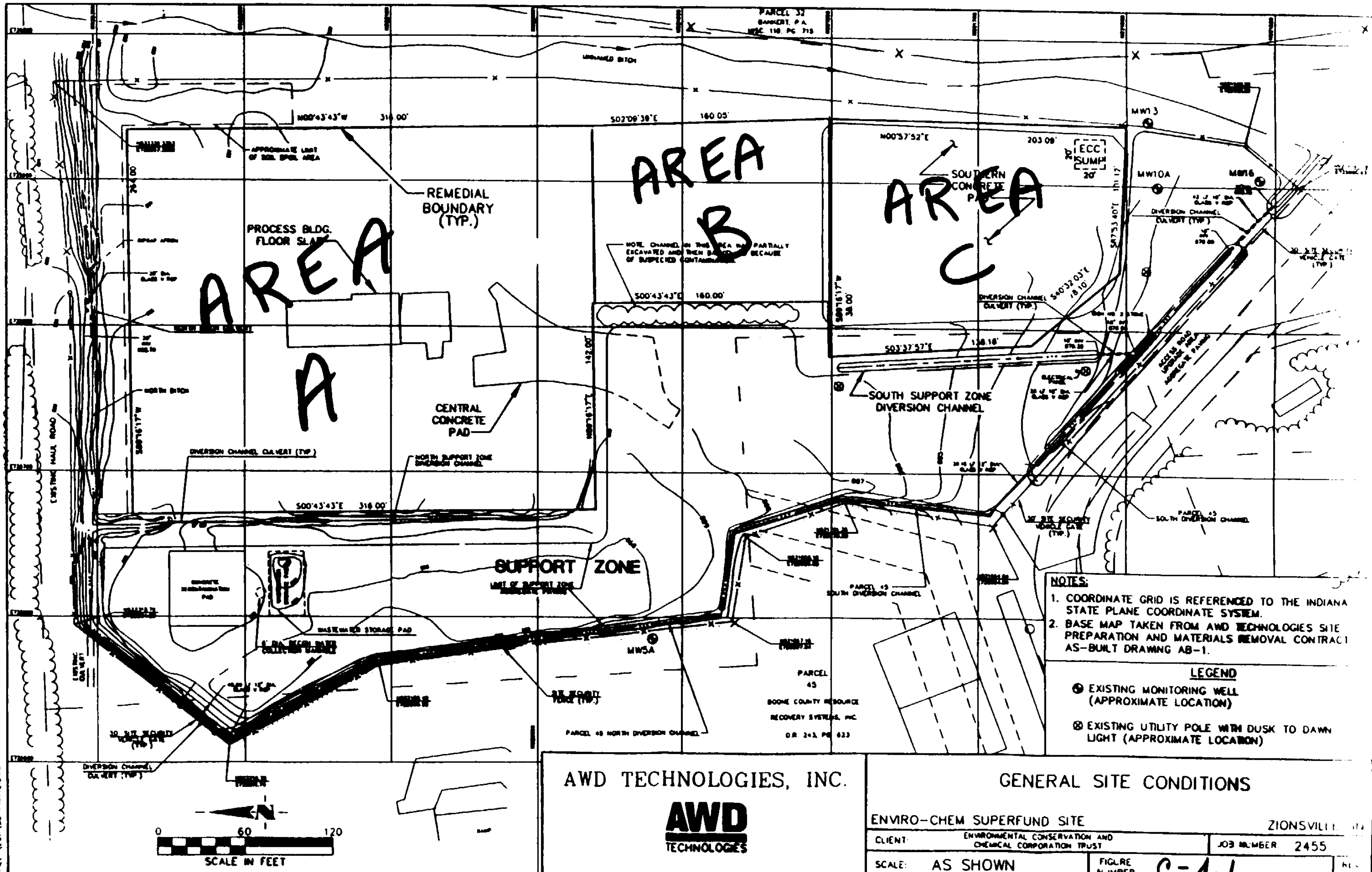
Q_C RANGE = 1.21 GPM TO 1.63 GPM
Q_C VERT FLOW = +2.0 GPM +2.0 GPM
(AWD, 3/93)

Q_C (TOTAL) = 3.21 GPM to 3.63 GPM

Q (All AREAS) = 0.48 to 0.88 GPM (A) + 0.14 to 0.26 GPM (B) + 3.21 to 3.63 GPM (C) = 3.83 to 4.77 GPM

The values calculated are estimates based upon the aquifer parameters defined by AWD PHASE II S.I. AND the available geologic/hydrogeologic data for the site. If vertical flow from the underlying sand and gravel aquifer occurs in either Area A or B, a significantly higher Q may result.

Q_{A+B} = 0.62 to 1.06 GPM


AREA A
AREA B
AREA C
REMEDIAL BOUNDARY (TYP.)
PROCESS BLDG. FLOOR SLAB
CENTRAL CONCRETE PAD
SOUTHERN CONCRETE PAD
ECC SUMP
SOUTH SUPPORT ZONE DIVERSION CHANNEL
SUPPORT ZONE
MW13
MW10A
MW5A
N00°43'43"W 316.00'
S02°09'38"E 160.05'
N00°57'52"E 203.09'
S00°43'43"E 316.00'
S00°43'43"E 160.00'
S03°37'57"E
NOTES:
1. COORDINATE GRID IS REFERENCED TO THE INDIANA STATE PLANE COORDINATE SYSTEM.
2. BASE MAP TAKEN FROM AWD TECHNOLOGIES SITE PREPARATION AND MATERIALS REMOVAL CONTRACT AS-BUILT DRAWING AB-1.
LEGEND
EXISTING MONITORING WELL (APPROXIMATE LOCATION)
EXISTING UTILITY POLE WITH DUSK TO DAWN LIGHT (APPROXIMATE LOCATION)
SCALE IN FEET
0
60
120
AWD TECHNOLOGIES, INC.
AWD TECHNOLOGIES
GENERAL SITE CONDITIONS
ENVIRO-CHEM SUPERFUND SITE
ZIONSVILLE
CLIENT:
ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION TRUST
JOB NUMBER 2455
SCALE: AS SHOWN
FIGURE NUMBER C-4.1

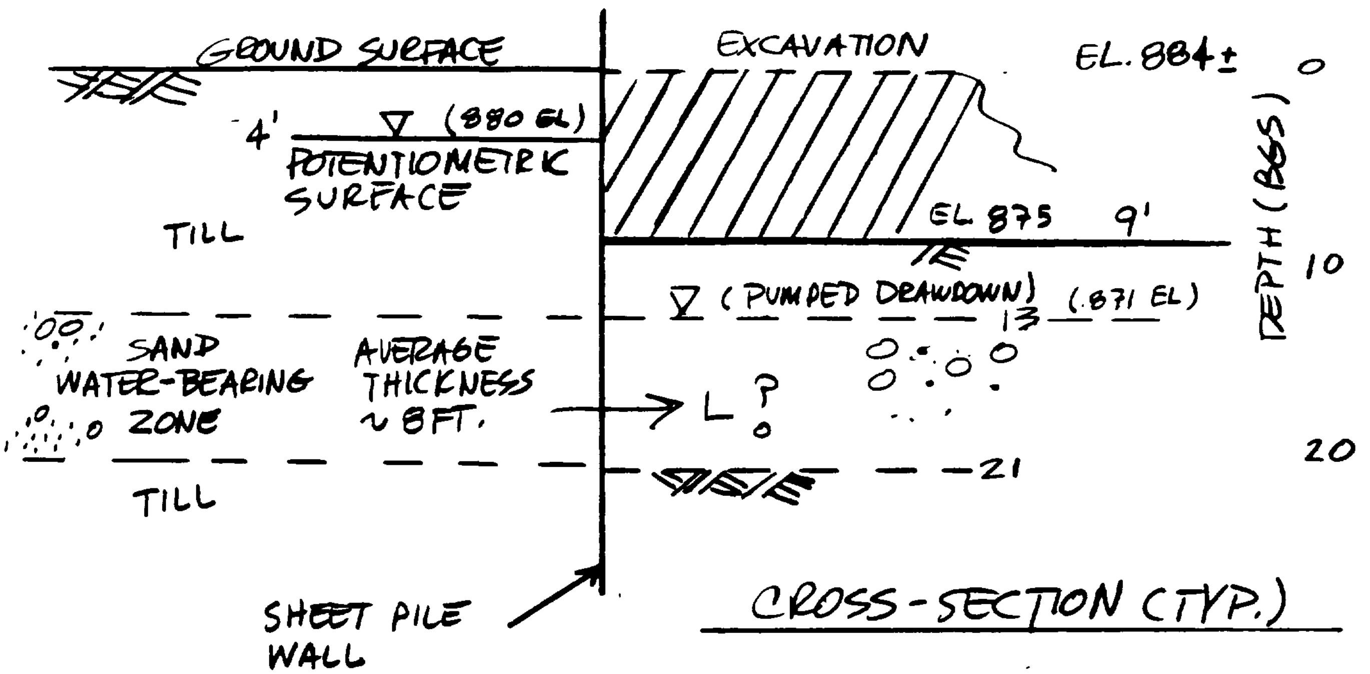
CALC. 4.1

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT: ENVIRO-CHEM	FILE NO.: 2455.001 (PD)	BY: M. DOWIAK	PAGE 1 OF 2
SUBJECT: EXCAVATION CUTOFF		CHECKED BY: J. Ambrose	DATE: 1/16/95

4.2 CUTOFF WALL DEWATERING



CROSS-SECTION (TYP.)

4.2.1 DEWATERING ESTIMATE

A. DARCY'S LAW METHOD

$$Q = KiA$$

WHERE K, HYDRAULIC CONDUCTIVITY OF SHEET PILE, FT/SEC
i, HYDRAULIC GRADIENT
A, SEEPAGE AREA, USE 510 FT × $\overline{8}$ FT

NOTE, SHEET PILE $K = \dfrac{L}{t}$

WHERE L, HORIZONTAL SHEET PILE WALL LEAKANCE, 1/TIME
t, EFFECTIVE THICKNESS OF STEEL SHEET

$$\therefore Q = \frac{L}{t} i (A)$$

SEE REFERENCE, ATTACHMENT 4.1, FOR STEEL SHEET 'L' (TABLE 5-5)

AWD021 5/90

AWD TECHNOLOGIES

CALCULATION WORKSHEET

CLIENT:	FILE NO.: 2455.001	BY: M. DOWIAK	PAGE 2 OF 2
SUBJECT:		CHECKED BY: J Ambrose	DATE: 1/16/95

4.2.1 (A) CONT.

$$Q = \frac{L}{t} i \, (A)$$

USE $L = 6.0 \times 10^{-4}$ TO 3.0×10^{-3} DAY^{-1} (AZ18)
0.028 TO 0.28 DAY^{-1} (Z75)

t = 1.0 FT (ATTACHMENT 4.1)
($\therefore$ $K = L/t = 6.0 \times 10^{-4}$ TO 3.0×10^{-3} FT/D)
i = 9.0
A = 4080 FT² → 215' × 40' × 8' HEIGHT

L	t	i	A	Q		SHEET
DAY^{-1}	FT		FT²	CFD	GPM	
6.0×10^{-4}	1.0	9	4080	22	0.11	AZ 18
3.0×10^{-3}	1.0	9	4080	110	0.57	AZ 18
0.28	1.0	9	4080	1.03×10^4	53.6	Z 75
0.028	1.0	9	4080	1.03×10^3	5.36	Z 75
4.7×10^{-3}	1.0	9	4080	173	0.90	BZ16.4

NOTES:

1. USE AZ OR BZ SHEET SECTIONS.
2. CHECK SHEET AVAILABILITY AND PROCUREMENT LEAD TIME (AFTER (3))
3. DESIGN CUT OFF AND DETERMINE SHEET SECTION MODULUS
4. DO PILE DRIVEABILITY TEST WITH SELECTED CONTRACTOR TO CONFIRM CONSTRUCTABILITY OF SELECTED SHEET

REF.: DOW CHEMICAL COMPANY
SHEET PILE WALL LEAKAGE TEST
JULY, 1993

ATTACHMENT 4.1 1/10

EXECUTIVE SUMMARY

The Dow Chemical Company is contemplating the use of sheet pile walls to impede groundwater flow at various locations beneath its facility. Several sheet pile designs were reviewed for potential use. The most effective sheet piles for impeding groundwater appear to be sheet piles with groutable joints (Canadian Metal Rolling Mills). However, presently available sheet piles with groutable joints are unable to withstand the driving forces required for installation at the facility. Arbed AZ18 piles were chosen as the presently available piles which provide the best balance of cost, drivability and ability to impede groundwater flow.

A geologically representative location within the facility was chosen to measure the ability of AZ18 piles to impede groundwater flow. The test site is underlain by typical geologic strata which include a silty/sandy transmissive zone overlying a continuous clay unit. Before installation of sheet piles, one production well and four observation wells were installed in the test area. The ability of transmissive zone to produce groundwater was measured by pumping the production well and measuring drawdown in the observation wells. Following this test, a 50 foot by 50 foot sheet pile wall enclosure (centered on the production well) was driven through the transmissive unit and seated in the underlying clay, approximately 37 feet below the surface.

After sheet pile wall installation, 10 additional observation wells were installed inside and outside the enclosure. A second transmissive zone test was performed to measure the decreased capacity of the transmissive zone to produce groundwater. This decrease was attributed to the sheet pile wall enclosure.

Specific conclusions from the test are as follows:

- AZ18 sheet piles reduced the sustainable pumping rate of the production well by 96.7%.

- Under conditions of the test, less than 0.128 gpm of water flowed through a 208 foot length (2,288 ft^2) of sheet pile wall installed in the silty/sandy unit.

- Installed AZ18 sheet piles were conservatively estimated to have a hydraulic conductivity (K) of to 6.3×10^{-4} to 2.6×10^{-3} ft/day (2.2×10^{-7} to 9.17×10^{-7} cm/sec) with a best estimate of 1.98×10^{-3} ft/day (6.98×10^{-7} cm/sec). The K values of clay (and those beneath the facility) range from 2.8×10^{-3} to 2.8×10^{-6} ft/day (1×10^{-6} to 1×10^{-9} cm/sec).

- Horizontal leakance is a hydraulic parameter which can be used to estimate sheet pile wall leakage at other locations. AZ18 sheet piles were found to have a leakance of between $6.3x10^{-4}$ and $2.6x10^{-3}$ day^{-1}, (day^{-1}: feet per day per foot of horizontal thickness) with a best estimate of $1.98x10^{-3}$ day^{-1}.

- Using results of this test a simple procedure has been developed to estimate sheet pile wall leakage at other locations (Figure 7-1). Assumptions inherent to the procedure are listed in Section 7.1

- Based on inspection of sheet pile joints pulled from the ground after the test, AZ18 sheet piles in the test area were sealed by clays smeared into sheet pile joints. Soil conditions at other locations should be examined prior to assuming that results from this test may be extrapolated to other locations.

- AZ18 sheet piles in the test area were effectively seated in a clay unit. Measurable leakage flowed through the sheet pile joints and not under the piles.

3/10

Table 5-5
Comparison to Results from Other Sheet Pile Wall Leakage Tests
The Dow Chemical Company

Sheet Pile Type	Horizontal Leakance (day^{-1})	Reference
Z 75 (not grouted)	0.28 to 0.028 (assuming effective thickness of 1 foot)	Cherry (unpublished, 1992)
Z 75 grouted with a bentonite/water slurry	$2.8x10^{-4}$ to $2.8x10^{-5}$ (assuming effective thickness of 1 foot)	Cherry (unpublished, 1992)
Z 75 grouted with an organic polymer	$2.8x10^{-6}$ to $2.8x10^{-7}$ (assuming effective thickness of 1 foot)	Cherry(unpublished, 1992)
BZ 16.4	$4.7x10^{-3}$	ENSR (July 1991)
AZ 18 (this test)	$2.6x10^{-3}$ to $6.3x10^{-4}$	This report

4/10

2.2 Sheet Pile Type

Arbed AZ 18 type sheet piles were chosen for this leakage test because they were most readily available and were able to withstand driving forces required to install piles at the DOW facility. Methods used to reach this choice are summarized below.

An initial list of 10 sheet pile types was compiled and compared for use in this project. Sheet piles were compared according to the following criteria:

- tightness of joint fit;
- ability to grout the joints;
- ability to withstand driving forces (drivability);
- availability of previous leakage measurements; and
- pile availability and cost.

5/10

After reviewing these criteria, the following short-list of potential sheet pile types to be tested was compiled:

- Canadian Metal Rolling Mills Z75 Series Sheet Piles with Groutable Joints (Waterloo Piles);
- Arbed BZ 16.4 Sheet Piles; and
- Arbed AZ 18 Sheet Piles.

Technical details regarding these sheet pile types are summarized below.

2.2.1 Canadian Metal Rolling Mills Z75 Series Sheet Piles with Groutable Joints (Waterloo Sheet Piles)

These sheet piles were developed in conjunction with the University of Waterloo (Waterloo, Ontario) for the purpose of impeding the migration of contaminated groundwater.

Pile Design

The Z75 sheet piles with groutable joints are cold rolled from a copper, nickel, iron alloy (see Appendix C) which is 0.295 inches (7.5 mm) thick. These piles have the same specifications as Canadian Steel Mills Z75 series piles. The only difference lies in the radius of the pile joints (see Figure 2-3). The joint radius is large enough to admit a tremie pipe for grout injection after the piles have been installed. The bottom of each pile joint is cut at an angle and closed with a welded metal plate.

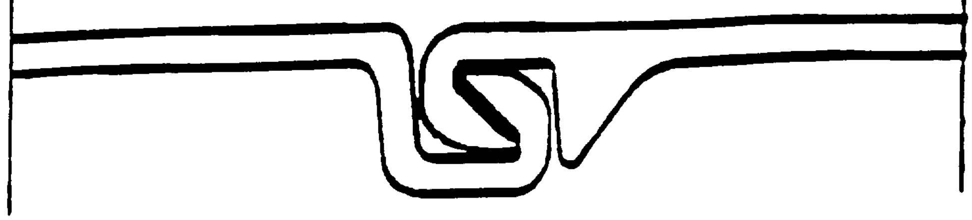
Pile Drivability

The Waterloo sheet piles are installed using normal pile driving procedures (drop hammer or vibratory hammer). After installation, a water lance is sent down the inside of a joint to flush out any soils which entered during installation. After flushing, a tremie pipe is inserted to the base of the joint, and grout is injected. Waterloo has used two types of grout: a bentonite/water slurry and an organic polymer (developed by DOW).

The piles have been installed into fine-grained sands with typical blow counts of 30 blows/ft to depths of 47 feet. The piles may withstand blow counts of up to 100 blows/ft. DOW experience at the facility indicates that piles can be driven through into a clay (C_2 Unit) underlying the first natural transmissive unit (S_1 Unit, see Section 3.2) with blow counts of less than 20 blows/ft. However, blow counts for piles entering the second natural transmissive unit (S_2 Unit)

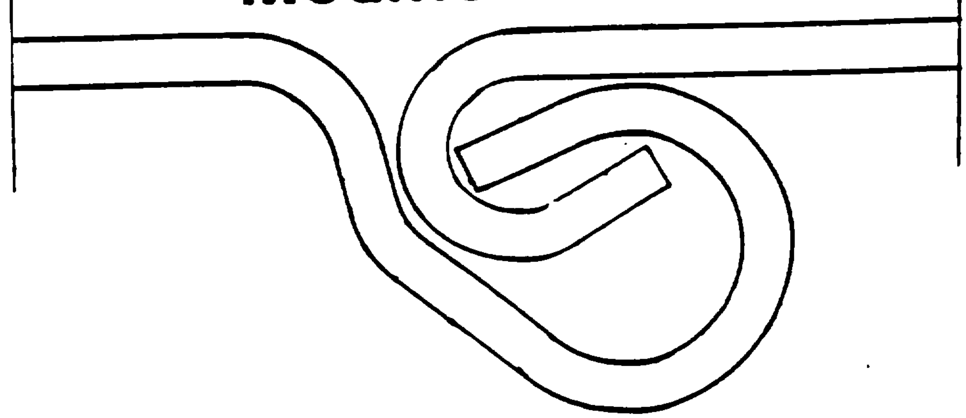
6/10

AZ



BZ

Modified Z75



NOT TO SCALE

FIGURE 2-3

SHEET PILE TYPES

The Dow Chemical Company

DRAWN: D.S.	DATE: December 10, 1992	PROJECT NO.: 2320-017-050	REV 1
FILE NO:	CHECKED: D.D.		

have been up to 120 blows/ft (at depths of between 50 ft and 60 ft below the surface). Canadian Metal Rolling Mills representatives have indicated that the groutable Z75 piles could be installed to the base of the C_2 unit, but that buckling and refusal could occur if more than 100 blows/foot are required. Mill representatives have indicated that (with re-tooling) 0.394-inch-thick (10 mm) sheet piles with groutable joints could be manufactured. These piles, although not tested, would be expected to withstand driving through the S_2 unit.

Pile Joint Hydraulic Conductivity

Waterloo tests of sheet pile wall enclosures indicate that Z75 sheet piles with groutable joints have the following average hydraulic conductivities as follows (Cherry, 1992).

Grout Type	Average Wall Hydraulic Conductivity
No grouting	0.28 to 0.028 ft/day ($1x10^{-4}$ to $1x10^{-5}$ cm/sec)
Bentonite/water Slurry	$2.8x10^{-4}$ to $2.8x10^{-5}$ ft/day ($1x10^{-7}$ to $1x10^{-8}$ cm/sec)
Organic Polymer	$2.8x10^{-6}$ to $2.8x10^{-7}$ ft/day ($1x10^{-9}$ to $1x10^{-10}$ cm/sec)

The higher hydraulic conductivities listed above are similar to those of silts. The lower hydraulic conductivities are similar to those of "impermeable" clays and landfill liner materials. Hydraulic conductivities equal to or lower than $2.8x10^{-4}$ ft/day ($1x10^{-7}$ cm/sec) are typically required by regulators for landfill liners.

Pile Availability

The Z75 sheet piles with groutable joints are manufactured by Canadian Metal Rolling Mills upon receipt of an order. The University of Waterloo controls distribution of the sheet piles. The time from order to delivery is typically 2 to 3 months. Delivered costs of the thicker piles have been estimated to be \$6.75/ft² to \$7.25/ft² (US dollars).

2.2.2 Arbed BZ 16.4 Sheet Piles

Pile Design

BZ 16.4 sheet piles are hot rolled from a copper, nickel, iron alloy (see Appendix C) which is 0.375 inches (9.5 mm) thick. These piles have the tightest fitting joints of the considered piles and will not admit a tremie rod for grouting (see Figure 2-3).

Pile Drivability

The BZ 16.4 sheet piles are installed using normal pile driving procedures (drop hammer or vibratory hammer). The piles were installed through fine grained sands and clays at the French Limited hazardous waste site (Crosby, Texas) with blow counts of up to 105 blows/ft at a depth of 50 feet.

Pile Joint Hydraulic Conductivity

A leakage test of a BZ 16.4 sheet pile wall (approximately 1 year after installation) was performed at the French Limited hazardous waste site in 1990 (ENSR, 1991). The test at that location provided sheet pile wall hydraulic conductivity estimates ranging between 0.002 ft/day (7.05×10^{-7} cm/sec) and 0.005 ft/day (1.76×10^{-6} cm/sec). These values are similar to those of silts or silty clays.

Pile Availability

Arbed has stopped production of BZ 16.4 sheet piles. The existing stock of these piles will be exhausted in 1993. Remaining BZ 16.4 piles have delivered costs of \$7/ft^2 to \$8/ft^2.

2.2.3 Arbed AZ 18 Sheet Piles

AZ 18 sheet piles have been installed along the River at the DOW facility to impede groundwater flow and to stabilize bank slopes.

Pile Design

AZ 18 piles are hot rolled from a copper, nickel, iron alloy (see Appendix C) which is 0.375 inches (9.5 mm) thick. These piles have a looser fitting joint than the BZ 16.4 piles, but they will also not admit a tremie rod for grouting (see Figure 2-3).

Pile Drivability

The AZ 18 sheet piles are installed using normal pile driving procedures (drop hammer or vibratory hammer). DOW has found that AZ 18 piles can be driven through to the base of the S_2 Unit with blow counts of up to 120 blows/ft (at depths of between 50 ft and 60 ft below the surface) without significant buckling of the piles.

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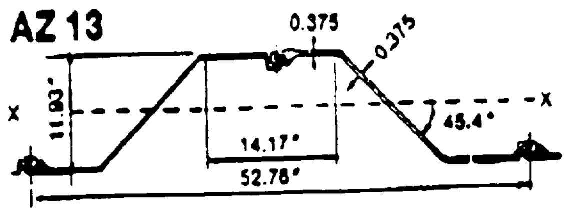
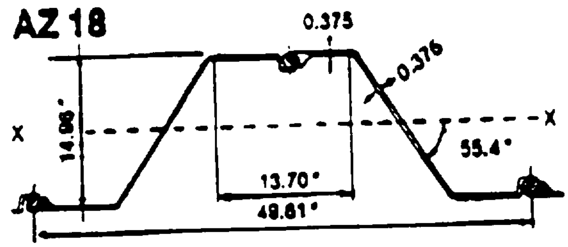
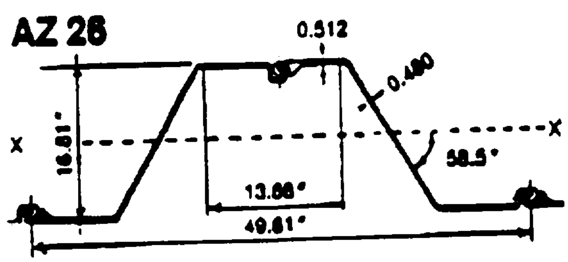
SKYLINE STEEL CORPORATION

AZ Sections







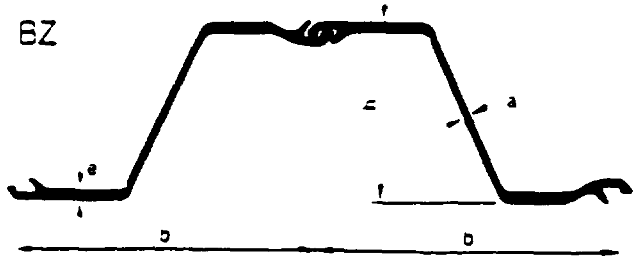
AZ sections are available in all standard qualities.
All sections can be rolled up by 0.02 in. and rolled down on request.
For corner arrangements special connectors are in stock.

AZ - Section	DIMENSIONS				WEIGHT		SECTION AREA	SECTION MODULUS	MOMENT of INERTIA
	W Width	H Height	A Flange	E Web	Per Lin Ft. of Pile	Per Sq. Ft. of Wall	Per Lin Ft. of Wall	Per Lin Ft. of Wall	Per Lin Ft. of Wall
	In.	In.	In.	In.	Lbs.	Lbs.	In.^{2}	In.^{3}	In.^{4}
AZ 13	28.38	11.93	0.375	0.375	48.38	21.92	6.47	24.2	144.3
RU +0.02	28.38	11.95	0.394	0.394	50.26	22.86	6.75	25.0	149.4
RD −0.02	28.38	11.91	0.355	0.355	46.83	21.22	6.26	23.4	139.2
AZ 18	24.805	14.96	0.375	0.375	49.98	24.17	7.09	33.6	250.4
RU +0.02	24.805	14.98	0.394	0.394	52.01	26.15	7.38	34.6	258.8
RD −0.02	24.805	14.94	0.355	0.355	48.25	23.35	6.85	32.5	242.4
AZ 26	24.805	16.81	0.512	0.480	65.72	31.75	9.35	48.4	406.5
RU +0.02	24.805	16.83	0.532	0.500	67.67	32.76	9.64	49.6	417.1

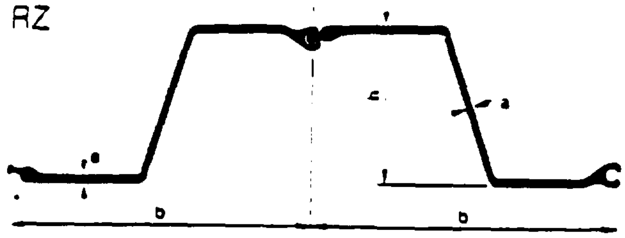
Section Properties

10/10

BZ



RZ



Section	Width	Depth	Flange thickness	Web thickness	Developed perimeter	Section area	Coating area	Mass		Section modulus	Moment of inertia	Radius of gyration
	b	h	e	a	*		**					r
	in	in	in	in	in/ft of wall	in²/ft of wall	ft²/ft of s. pile	lbs/ft of s. pile	lbs/ft² of wall	in³/ft of wall	in⁴/ft of wall	in
BZ 7	21.65	7.48	315	315	28.2	5.57	4.40	34.27	19.0	14.0	52.5	3.07
BZ 8.6	21.65	7.60	.375	375	28.2	6.43	4.40	39.51	21.9	16.0	60.8	3.08
BZ 12	19.69	9.57	335	335	32.8	6.76	4.63	37.70	23.0	22.3	106.4	3.97
BZ 12.1 L	22.64	10.28	375	375	30.1	6.74	4.86	43.27	22.9	22.5	115.5	4.14
RZ 10	21.65	11.26	.394	375	34.2	7.75	5.15	47.71	26.4	30.5	172.1	4.72
BZ 16.4	19.69	11.81	375	375	34.6	7.75	4.86	43.27	26.4	30.5	180.0	4.82
BZ 17	19.69	11.81	.394	375	34.6	7.89	4.86	43.96	26.8	31.1	183.7	4.83
RZ 11	19.10	11.93	.394	375	38.4	8.79	5.15	47.71	30.0	37.2	221.9	5.02
BZ 20.7 L	22.64	12.80	.520	.394	32.5	8.86	5.25	56.85	30.2	38.4	245.9	5.27
BZ 26	19.69	13.78	520	394	37.4	10.20	5.25	56.85	34.7	48.2	331.9	5.71
BZ 32	19.69	13.86	.748	.453	37.3	12.52	5.25	69.82	42.5	59.4	411.7	5.74
BZ 37	19.69	13.78	.787	.472	38.8	14.08	5.45	78.62	47.9	67.9	467.7	5.76
BZ 42	19.69	13.94	945	551	38.9	16.30	5.48	90.92	55.4	78.2	544.4	5.78

* Perimeter of joints excluded
** Inside of interlocks not included

The Z series offers:
- An outstanding geometrical yield, resulting in minimum cost per square foot of wall at a given section modulus.
- An optimum effective width which represents a good compromise between driving behavior and search of moderate driving costs.
- The extra-strong joints:
  - jaw-interlock minimizing the risk of interlock failure
  - ball and socket interlock allowing at the same time a large swing.

The two joint types (BZ and RZ) do not interlock with each other.

Special Piles

All connection piles, corners and junction sheet piles (bent, welded or bolted), box piles are available from the mills upon request.

CALCULATION NUMBER 5.0

STORMWATER DRAINAGE SYSTEM

Determine the maximum flow conveyed by each channel

Contributing watershed areas (direct)

Channel A	32972	sf =	0.76	ac
Southern Diversion - Reach 1	27574	sf =	0.63	ac
Southern Diversion - Reach 3	2068	sf =	0.62	ac
Northern Diversion - Reach 1	33680	sf =	0.77	ac
Northern Diversion - Reach 2	14574	sf =	0.33	ac

The flows will be calculated using the SCS TR-55 Method as outlined in "Urban Hydrology for Small Watersheds", United States Department of Agriculture Soil Conversation Service, Engineering Division, Technical Release 55, June 1986.

The channels will be designed to adequately convey the runoff from a 25-year, 24 hour storm event.

Rainfall = 4.8 in (See page 12)

The cover soils are assumed to be classified as hydrologic soil group C. Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. (See page 13)

Determine Runoff Curve Number
Conservatively assume cover type similar to "Pasture, grassland, or range-continuous forage for grazing, poor hydrologic condition". CN = 86 (See page 14)

Discharge $q_p = (q_u)(A_m)(Q)(F_p)$

F_p= Pond and swamp adjustment factor (=1 for zero percent pond and swamp)
A_m = Area in square miles
Q = Runoff (using Figure 2-1 page 15 for fainfall = 4.8 in and CN = 86 , Q = 3.2 in
q_u = unit peak discharge (conservatively assume time of concentration, Tc = 0.1 hr
I_a = initial abstraction, using Table 4-1, page 16 for CN = 86, I_a = 0.326
I_a/p = 0.326/48 = 0.07 ~0.10
Using tabular hydrograph for Type II rainfall distrubution for I_a/P = 0.10, Tc = 0.1 hr, Tt = 0

Unit peak discharge = 1010 csm/in (See page 17)
See page 18 for figure used to determine rainfall distribution type.

$q_p = (1010)(3.2)(1.0)(A_m)$
$q_p = (3232)Am$ (in ft^3/sec)

Determine peak flows for each channel

Channel A	0.76	ac /	640	mi/ac x	3232	=	3.84	cfs				
Southern Diversion - Reach 1	0.63	ac /	640	mi/ac x	3232	=	3.18	cfs				
Southern Diversion - Reach 2	0.62	ac /	640	mi/ac x	3232	+	3.84	+	3.18	=	10.15	cfs
Northern Diversion - Reach 1	0.77	ac /	640	mi/ac x	3232	=	3.89	cfs				
Northern Diversion - Reach 2	0.33	ac /	640	mi/ac x	3232	+	3.89	=	5.56			cfs

Determine Manning "n" coefficient

Following procedure obtained from "Open-Channel Hydraulics" by Richard H French, 1985.

Soil Conservation Service (SCS) Method (pages 119-123)

Basic n - Channels in earth : n=0.02 (Table 4.2 - page 120)

Modifying factors for vegetation: 0.010-0.025 (Table 4.3, page 122)

Assume turf grasses where the average depth of flow in 1 to 2 times the height of vegetation

Modification for channel irregularity: 0.005 (Table 4.4, page 122)

Assume large and small sections alternating occasionally or shape changes causing occasional shifting of main flow from side to side.

Modifying factors for channel surface irregularity: 0.000 (Table 4.5, page 122)

Assume the best obtainable for the materials involved.

Modification for obstruction: 0.000 (Table 4.6, Page 123)

Assume negligible.

Modification for Channel Alignment: 0.000 (Table 4.7, page 123)

Assume minor degree of meandering.

Estimate of "n" = 0.035 to 0.050

All channels (except the lower end of Channel at the intersection with South Channel) will be grass lined. A Manning "n" coefficient of 0.035 as determined previously will be used to calculate the maximum flow velocity and a coefficient of 0.050 will be used to determine the depth of flow compared to the channel depth and 0.5 foot minimum freeboard requirement.

Solving the equation $Q=1.49/2(A)(R)^{2/3}(s)^{1/2}$ for depth (d) results in the actual depth of flow resulting for a given flow.

Q is flow in cfs, A is area in flow, R is hydraulic radius, and s is slope .

For a "V" channel with 2:1 side slopes

$A = d(2d) = 2d^2$

R = A/Wp where Wp (wetted perimeter) = $2(d2+4d2)^{1/2}=2(5d2)^{1/2}$

Therefore $R= 2d^2/(2(5d^2)^{1/2}) = d^2/2.24d = d/2.24$

Substituting for $AR^{2/3}$ and solving for d the following is arrived at:

$1.16d^{8/3}=(Q)(n)/(1.49(S)^{1/2})$ or

$d^{8/3} = 0.58(Q)(n)/(s)^{1/2}$

FOR CHANNEL A

Q =	3.84	cfs							
n =	0.05								
s =	0.01								
$d^{8/3}$ =	0.58	X	3.84	X	0.05	/	0	$^{1/2}$=	1.11
d =	1.11	$^{3/8}$	=		1.04	ft	OK, freeboard>0.5'		

check velocity

$v = (1.49/(n))(R)^{2/3}(s)^{1/2}$

From above R=d/2.24 so,

R =	1.04	/	2.24	=	0.46					
v =	1.49	/	0.035	X	0.46	$^{2/3}$X	0	$^{1/2}$=	2.54	fps

FOR SUPPORT ZONE SOUTHERN CHANNEL, REACH 1

Q =	3.18	cfs							
n =	0.05								
s =	0.02								
$d^{8/3}$ =	0.58	X	3.18	X	0.05	/	0	$^{1/2}$=	0.65
d =	0.65	$^{3/8}$	=		0.85	ft	OK, freeboard>0.5'		

check velocity

$v = (1.49/(n))(R)^{2/3}(s)^{1/2}$

From above R=d/2.24 so,

R =	0.85	/	2.24	=	0.38					
v =	1.49	/	0.035	X	0.38	$^{2/3}$X	0	$^{1/2}$=	3.16	fps

FOR SUPPORT ZONE SOUTHER CHANNEL, REACH 2

Q =	10.15	cfs							
n =	0.05								
s =	0.02								
$d^{8/3}$ =	0.58	X	10.15	X	0.05	/	0	$^{1/2}$=	2.08

Client: ECC File:2455 By: JRC Page: 7 of 19

Subject: Storm Calcs Checked: Date:

d =	2.08	$^{3/8}$	=			1.32	ft	OK, freeboard>0.5'			
check velocity											
$v = (1.49/(n))(R)^{2/3}(s)^{1/2}$											
From above R=d/2.24 so,											
R =	1.32	/	2.24		=	0.59					
v =	1.49	/	0.035		X	0.59	$^{2/3}$X	0	$^{1/2}$=	4.24	fps
FOR SUPPORT ZONE NORTHERN CHANNEL, REACH 1											
Q =	3.89	cfs									
n =	0.05										
s =	0.005										
$d^{8/3}$ =	0.58	X	3.89		X	0.05	/	0	$^{1/2}$=	1.6	
d =	1.6	$^{3/8}$	=			1.19	ft	OK, freeboard>0.5'			
check velocity											
$v = (1.49/(n))(R)^{2/3}(s)^{1/2}$											
From above R=d/2.24 so,											
R =	1.19	/	2.24		=	0.53					
v =	1.49	/	0.035		X	0.53	$^{2/3}$X	0	$^{1/2}$=	1.97	fps
FOR SUPPORT ZONE NORTHERN CHANNEL, REACH 2											
Q =	5.56	cfs									
n =	0.05										
s =	0.005										
$d^{8/3}$ =	0.58	X	5.56		X	0.05	/	0	$^{1/2}$=	2.28	
d =	2.28	$^{3/8}$	=			1.36	ft	OK, freeboard>0.5'			
check velocity											
$v = (1.49/(n))(R)^{2/3}(s)^{1/2}$											
From above R=d/2.24 so,											
R =	1.36	/	2.24		=	0.61					
v =	1.49	/	0.035		X	0.61	$^{2/3}$X	0	$^{1/2}$=	2.17	fps
For a "V" channel with 1:1 side slopes											
$A = d(d) = d^2$											
$R = A/Wp$ where Wp (wetted perimeter) $= 2(d2+d2)^{1/2} = 2(d2)^{1/2}$											
Therefore $R = d^2/(2(d^2)^{1/2}) = d/2.83$											
Substituting for $AR^{2/3}$ and solving for d the following is arrived at:											
$0.5d^{8/3} = (Q)(n)/(1.49(S)^{1/2})$ or											
$d^{8/3} = 1.34(Q)(n)/(s)^{1/2}$											

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FOR CHANNEL A INTERSECTION WITH SOUTH CHANNEL REACH 1											
Q =	3.84	cfs									
n =	0.045										
s =	0.5										
$d^{8/3}$ =	1.34	X	3.84		X	0.045	/	0.5	$^{1/2}$=	0.33	
d =	0.33	$^{3/8}$	=			0.66	ft	OK, freeboard>0.5'			
check velocity											
v = $(1.49/(n))(R)^{2/3}(s)^{1/2}$											
From above R=d/2.24 so,											
R =	0.66	/	2.83		=	0.23					
v =	1.49	/	0.045		X	0.23	$^{2/3}$X	0.5	$^{1/2}$=	8.79	fps
For trapezoidal channels											
Solve for the maximum hydraulic properties (AR2/3) based on expected flow and channel slope.											
Then solve for hydraulic properties based on channel geometry and varying depths.											
Assume side slopes are all 1.5:1 and bottom width of 2 feet											
FOR NORTHERN DIVERSION CHANNEL											
Contributing drainage area=3.21 acres =						0.005	mi				
From previous calcs qp= 3232XAm=						16.16	cfs				
Q=	16.16	cfs									
$AR^{2/3}=Qn/(1.49*(s)^{1/2})$											
Q=	17.5										
n=	0.045										
s=	0.015										
AR2/3=	4.32	=	maximum expected hydraulic condition based on calculated flow								
Solve for depths											
D	A		Wp			R		$R^{2/3}$		$AR^{2/3}$	
1	3.5		5.61			0.62		0.7		2.54	Inadequate
1.5	6.375		7.41			0.86		0.9		5.77	OK
check velocity											
v = $(1.49/(n))(R)^{2/3}(s)^{1/2}$											
Assume full flow at D=1.4, therefore R=						0.86					
v =	1.49	/	0.045		X	0.86	$^{2/3}$X	0	$^{1/2}$=	3.67	fps
FOR SOUTH DIVERSION CHANNEL, REACH 1											
Contributing drainage area=1.21 acres =						0.002	mi^2				
From previous calcs qp= 3232XAm=						6.14	cfs				
Q=	6.14	cfs									

$AR^{2/3}=Qn/(1.49*(s)^{1/2})$											
Q=	6.14										
n=	0.045										
s=	0.015										
AR2/3=	1.51	=	maximum expected hydraulic condition based on calculated flow								
Solve for depths											
D	A		Wp			R		$R^{2/3}$		$AR^{2/3}$	
0.5	1.375		3.8			0.36		0.5		0.7	Inadequate
1	3.5		5.61			0.62		0.7		2.54	OK
check velocity											
$v = (1.49/(n))(R)^{2/3}(s)^{1/2}$											
Assume full flow at D=4.5, therefore R=						0.62					
v =	1.49	/	0.045		X	0.62	$^{2/3}$X	0	$^{1/2}$=	2.95	fps
FOR SOUTH DIVERSION CHANNEL, REACH 2											
Q=	6.14	+	10.15								
$AR^{2/3}=Qn/(1.49*(s)^{1/2})$											
Q=	16.29										
n=	0.045										
s=	0.015										
AR2/3=	4.02	=	maximum expected hydraulic condition based on calculated flow								
Solve for depths											
D	A		Wp			R		$R^{2/3}$		$AR^{2/3}$	
1	3.5		5.61			0.62		0.7		2.54	Inadequate
1.5	6.375		7.41			0.86		0.9		5.77	OK
check velocity											
$v = (1.49/(n))(R)^{2/3}(s)^{1/2}$											
Assume full flow at D=4.5, therefore R=						0.86					
v =	1.49	/	0.045		X	0.86	$^{2/3}$X	0	$^{1/2}$=	3.67	fps

Subject: Storm Calcs Checked:_____ Date:_____

Culvert calculations

Assume full flow conditions in all pipes

From "Design and Construciton of Sanitary and Storm Sewers", Water Pollution Control Federation, 4th printing, 1970

Manning n=0.011 to 0.015, use 0.013 (see page 19)

Q=vA

From the "Standard Handbook for Civil Engineers", McGraw Hill, Pages 21-41

For Culvert No.1

$v=(H/((1+K_e/2g)+(n^2L/2.21R^{4/3})))^{1/2}$

Ke=	0.9	conservatively assumed based on sharp edged projecting inlet		
g =	32.2			
n=	0.013			
L=	65			
R= A/Wp				
A=3.14Xr²				
Wp=2X3.14Xr				
Qmax=	3.89			
s=	0.015			
Pipe size=	12	in		
H=depth of water at entrance=			1.19	ft
A=	0.785	ft²		
Wp=	3.14	ft		
R=	0.25	ft		
v=	4.41	ft/sec		
Q=vA=	3.46	cfs	Will not pass expected flow	
However if 2-12 inch pipes are used				
Q=	6.92	cfs	>Qmax, Sufficient pipe size	
Pipe size=	18	in		
H=depth of water at entrance=			1.19	ft
A=	1.77	ft²		
Wp=	4.71	ft		
R=	0.38	ft		
v=	5	ft/sec		
Q=vA=	8.85	cfs	>Qmax, Sufficient pipe size	

For Culvert No.2

$v=(H/((1+K_e/2g)+(n^2L/2.21R^{4/3})))^{1/2}$

Ke=	0.9	conservatively assumed based on sharp edged projecting inlet
g =	32.2	
n=	0.013	
L=	40	
R= A/Wp		
A=3.14Xr²		
Wp=2X3.14Xr		
Qmax=	16.2	

s=	0.0175			
Pipe size=	12	in		
H=depth of water at entrance=			1.5	ft
A=	0.785	ft^2		
Wp=	3.14	ft		
R=	0.25	ft		
v=	5.54	ft/sec		
Q=vA=	4.35	cfs	Will not pass expected flow	
Pipe size=	18	in		
H=depth of water at entrance=			1.5	ft
A=	1.77	ft^2		
Wp=	4.71	ft		
R=	0.375796	ft		
v=	6.06	ft/sec		
Q=vA=	10.73	cfs	Will not pass expected flow	
Pipe size=	24	in		
H=depth of water at entrance=			1.5	ft
A=	3.14	ft^2		
Wp=	6.28	ft		
R=	0.5	ft		
v=	6.35	ft/sec		
Q=vA=	19.94	cfs	Sufficient pipe size	
Pipe size=	30	in		
H=depth of water at entrance=			1.5	ft
A=	4.91	ft^2		
Wp=	7.85	ft		
R=	0.625478	ft		
v=	6.53	ft/sec		
Q=vA=	32.06	cfs	>Qmax, Sufficient pipe size	
For Culvert No.3				
$v=(H/((1+K_e/2g)+(n^2L/2.21R^{4/3})))^{1/2}$				
Ke=	0.9	conservatively assumed based on sharp edged projecting inlet		
g =	32.2			
n=	0.013			
L=	40			
R= A/Wp				
$A=3.14Xr^2$				
Wp=2X3.14Xr				
Qmax=	6.14			
s=	0.085			
Pipe size=	12	in		
H=depth of water at entrance=			3	ft
A=	0.785	ft^2		
Wp=	3.14	ft		
R=	0.25	ft		

v=	7.83	ft/sec		
Q=vA=	6.15	cfs	>Qmax, Sufficient pipe size	
For Culvert No.4				
$v=(H/((1+K_e/2g)+(n^2L/2.21R^{4/3})))^{1/2}$				
Ke=	0.9	conservatively assumed based on sharp edged projecting inlet		
g =	32.2			
n=	0.013			
L=	42			
R= A/Wp				
$A=3.14Xr^2$				
Wp=2X3.14Xr				
Qmax=	16.29			
s=	0.006			
Pipe size=	18	in		
H=depth of water at entrance=			1.25	ft
A=	1.76625	ft^2		
Wp=	4.71	ft		
R=	0.375	ft		
v=	5.5	ft/sec		
Q=vA=	9.714375	cfs	Will not pass expected flow	
s=	0.03			
Pipe size=	18	in		
H=depth of water at entrance=			1.25	ft
A=	1.76625	ft^2		
Wp=	4.71	ft		
R=	0.375	ft		
v=	5.5	ft/sec		
Q=vA=	9.71	cfs	Will not pass expected flow	
However if 2-18 inch pipes are used at a 3% slope				
Q=	19.42	cfs	>Qmax, Sufficient pipe size	
s=	0.03			
Pipe size=	24	in		
H=depth of water at entrance=			1.25	ft
A=	3.14	ft^2		
Wp=	6.28	ft		
R=	0.5	ft		
v=	5.77	ft/sec		
Q=vA=	18.12	cfs	>Qmax, Sufficient pipe size	
For Culvert No.5				
$v=(H/((1+K_e/2g)+(n^2L/2.21R^{4/3})))^{1/2}$				
Ke=	0.9	conservatively assumed based on sharp edged projecting inlet		
g =	32.2			

n=	0.013			
L=	40			
R= A/Wp				
A=3.14Xr^2				
Wp=2X3.14Xr				
Qmax=	10.15			
s=	0.025			
Pipe size=	15	in		
H=depth of water at entrance=			1.32	ft
A=	1.226563	ft^2		
Wp=	3.925	ft		
R=	0.3125	ft		
v=	5.48	ft/sec		
Q=vA=	6.72	cfs	Will not pass expected flow	
s=	0.027			
Pipe size=	15	in		
H=depth of water at entrance=			1.32	ft = existing flowline elevations
A=	1.23	ft^2		
Wp=	3.93	ft		
R=	0.31	ft		
v=	5.47	ft/sec		
Q=vA=	6.73	cfs	Will not pass expected flow	
However if 2-15 inch pipes are used at a 2.7% slope				
Q=	13.46	cfs	>Qmax, Sufficient pipe size	
s=	0.027			
Pipe size=	24	in		
H=depth of water at entrance=			1.32	ft = existing flowline elevations
A=	3.14	ft^2		
Wp=	6.28	ft		
R=	0.5	ft		
v=	5.93	ft/sec		
Q=vA=	18.62	cfs	>Qmax, Sufficient pipe size	

BACKUP INFORMATION

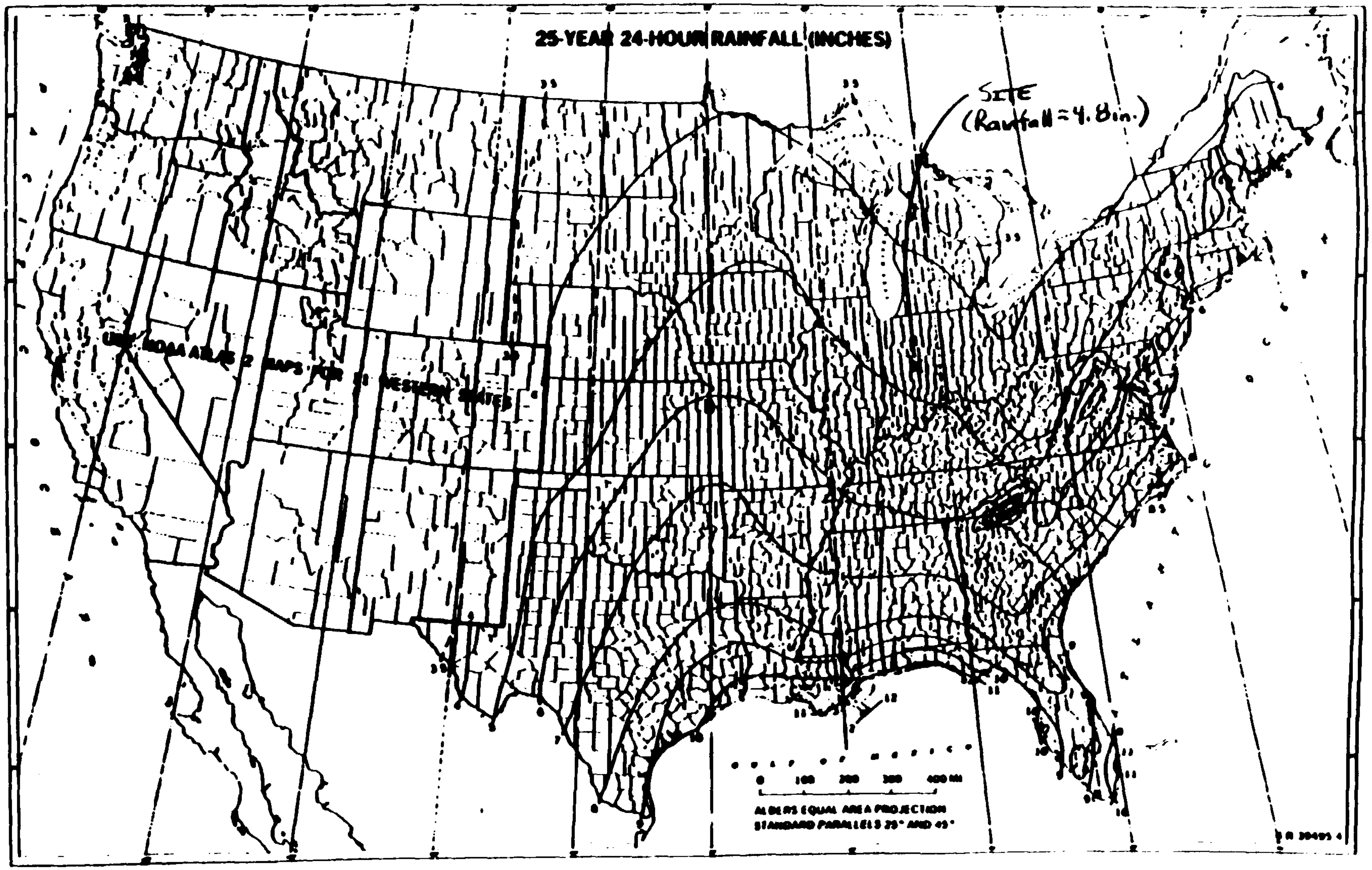

Figure B-6.—Twenty-five-year, 24-hour rainfall.

REF. Urban Hydrology for Small Watersheds

Appendix A: Hydrologic soil groups

Soils are classified into hydrologic soil groups (HSG's) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve numbers (see chapter 2). For the convenience of TR-55 users, exhibit A-1 lists the HSG classification of United States soils.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate—the rate at which the water moves within the soil. This rate is controlled by the soil profile. Approximate numerical ranges for transmission rates shown in the HSG definitions were first published by Musgrave (USDA 1955). The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Disturbed soil profiles

As a result of urbanization, the soil profile may be considerably altered and the listed group classification may no longer apply. In these circumstances, use the following to determine HSG according to the texture of the new surface soil, provided that significant compaction has not occurred (Brakensiek and Rawls 1983):

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Drainage and group D soils

Some soils in the list are in group D because of a high water table that creates a drainage problem. Once these soils are effectively drained, they are placed in a different group. For example, Ackerman soil is classified as A/D. This indicates that the drained Ackerman soil is in group A and the undrained soil is in group D.

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Table 2-2c.—Runoff curve numbers for other agricultural lands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	$\boxed{86}$	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[4]30	48	65	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	[4]30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1] Average runoff condition, and $I_a = 0.2S$.

[2] *Poor:* <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

[3] *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4] Actual curve number is less than 30; use CN = 30 for runoff computations.

[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6] *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Ref: ~~Urban Hydrology~~ for Small Watersheds

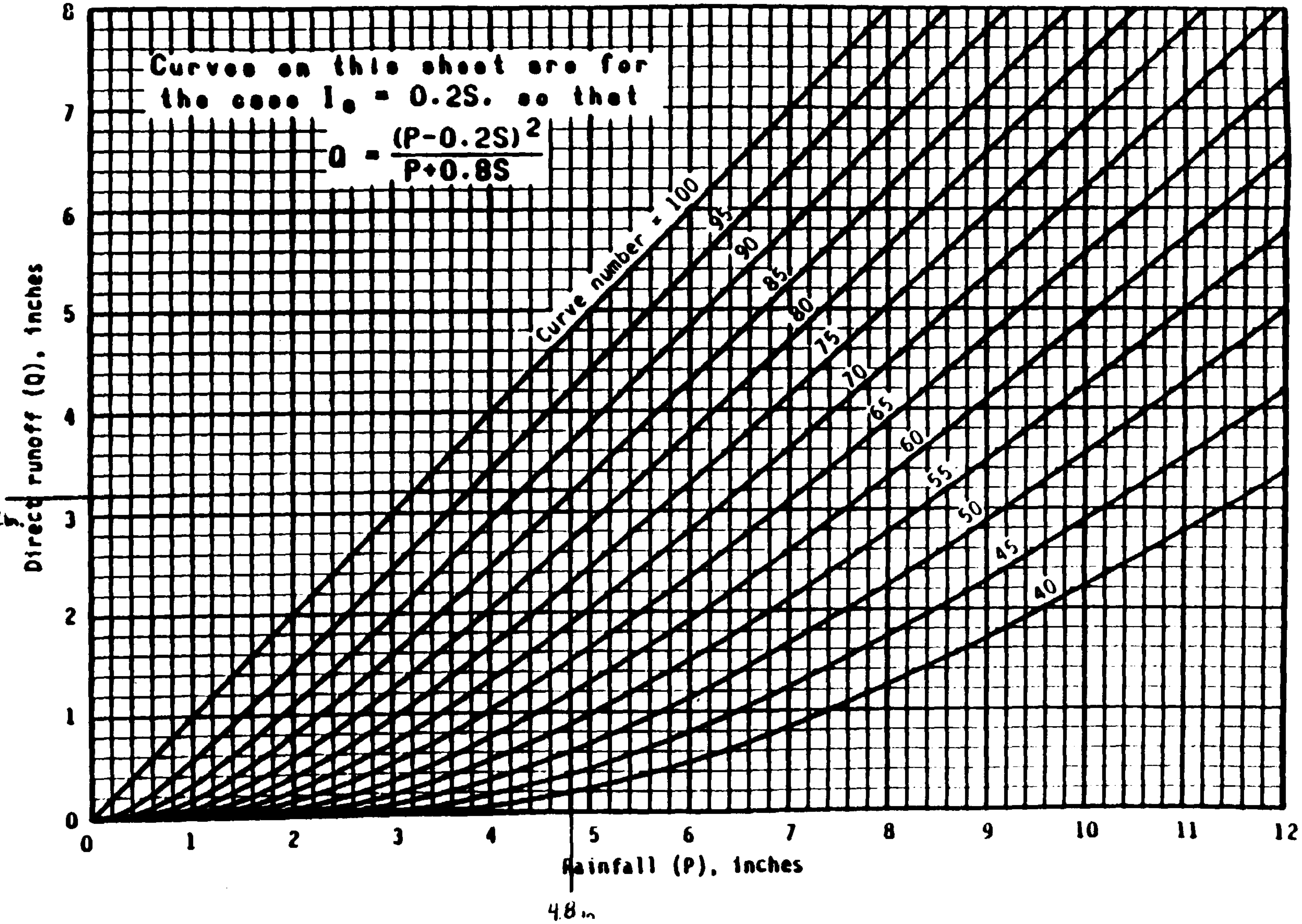

Figure 2-1.—Solution of runoff equation.

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Chapter 4: Graphical Peak Discharge method

This chapter presents the Graphical Peak Discharge method for computing peak discharge from rural and urban areas. The Graphical method was developed from hydrograph analyses using TR-20, "Computer Program for Project Formulation—Hydrology" (SCS 1983). The peak discharge equation used is

$$q_p = q_u A_m Q F_p \qquad \text{[Eq. 4-1]}$$

where

q_p = peak discharge (cfs);
q_u = unit peak discharge (csm/in);
A_m = drainage area (mi²);
Q = runoff (in); and
F_p = pond and swamp adjustment factor.

The input requirements for the Graphical method are as follows: (1) T_c (hr), (2) drainage area (mi²), (3) appropriate rainfall distribution (I, IA, II, or III), (4) 24-hour rainfall (in), and (5) CN. If pond and swamp areas are spread throughout the watershed and are not considered in the T_c computation, an adjustment for pond and swamp areas is also needed.

Peak discharge computation

For a selected rainfall frequency, the 24-hour rainfall (P) is obtained from appendix B or more detailed local precipitation maps. CN and total runoff (Q) for the watershed are computed according to the methods outlined in chapter 2. The CN is used to determine the initial abstraction (I_a) from table 4-1. I_a/P is then computed.

If the computed I_a/P ratio is outside the range shown in exhibit 4 (4-I, 4-IA, 4-II, and 4-III) for the rainfall distribution of interest, then the limiting value should be used. If the ratio falls between the limiting values, use linear interpolation. Figure 4-1 illustrates the sensitivity of I_a/P to CN and P.

Peak discharge per square mile per inch of runoff (q_u) is obtained from exhibit 4-I, 4-IA, 4-II, or 4-III by using T_c (chapter 3), rainfall distribution type, and I_a/P ratio. The pond and swamp adjustment factor is obtained from table 4-2 (rounded to the nearest table value). Use worksheet 4 in appendix D to aid in computing the peak discharge using the Graphical method.

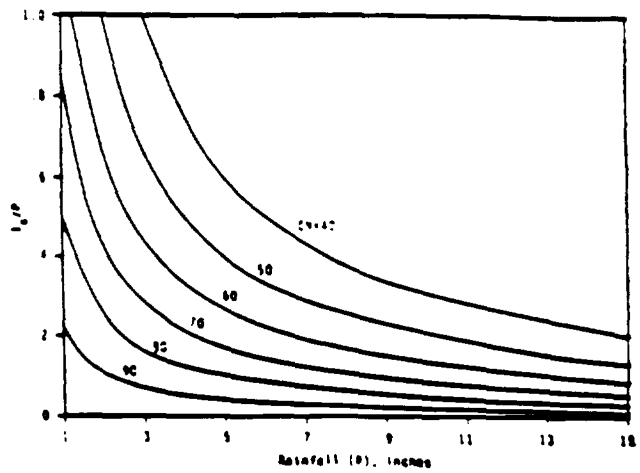

Figure 4-1.—Variation of I_a/P for P and CN.

Table 4-1.—I_a values for runoff curve numbers

Curve number	I_a (in)	Curve number	I_a (in)
40	3.000	70	0.857
41	2.878	71	0.817
42	2.762	72	0.778
43	2.651	73	0.740
44	2.545	74	0.703
45	2.444	75	0.667
46	2.348	76	0.632
47	2.255	77	0.597
48	2.167	78	0.564
49	2.082	79	0.532
50	2.000	80	0.500
51	1.922	81	0.469
52	1.846	82	0.439
53	1.774	83	0.410
54	1.704	84	0.381
55	1.636	85	0.353
56	1.571	86	0.326
57	1.509	87	0.299
58	1.448	88	0.273
59	1.390	89	0.247
60	1.333	90	0.222
61	1.279	91	0.198
62	1.226	92	0.174
63	1.175	93	0.151
64	1.125	94	0.128
65	1.077	95	0.105
66	1.030	96	0.083
67	0.985	97	0.062
68	0.941	98	0.041
69	0.899		

REF: Urban Hydrology for Small Watersheds

Exhibit 5-II: Tabular hydrograph unit discharges (csm/in) for type II rainfall distribution

HYDROGRAPH TIME (HOURS)

TRVL TIME (HR)	11.0	11.3	11.6	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	13.0	13.2	13.4	13.6	13.8	14.0	14.3	14.6	15.0	15.5	16.0	16.5	17.0	17.5	18.0	19.0	20.0	22.0	26.0
IA/P = 0.10														* * * TC = 0.1 HR * * *															IA/P = 0.10			
0.0	26	34	53	234	647	$\boxed{1010}$	623	217	147	123	104	86	76	66	57	51	46	42	38	34	32	29	26	23	21	20	19	18	15	13	12	0
.10	21	29	43	134	267	520	847	701	378	224	157	122	98	75	64	56	50	45	41	36	33	30	27	24	21	20	19	18	16	13	12	0
.20	14	25	35	61	110	215	418	704	762	484	312	209	151	94	73	62	54	49	44	38	34	31	28	25	22	21	19	18	16	14	12	0
.30	17	23	33	56	92	174	337	582	662	565	359	229	190	109	79	65	56	50	45	39	35	32	29	25	22	21	20	18	16	14	12	0
.40	15	20	28	41	51	78	142	272	478	601	563	447	325	172	104	76	63	55	49	42	37	33	29	26	23	21	20	19	17	14	12	0
.50	14	19	26	39	47	65	117	220	392	531	553	482	380	209	121	84	67	57	51	43	38	35	30	27	23	21	20	19	17	14	12	0
.75	12	15	21	29	33	38	49	73	126	224	343	432	464	385	252	156	103	76	62	50	43	36	31	28	25	22	21	19	17	15	12	0
1.0	9	12	15	21	23	26	29	33	40	55	96	148	238	406	434	317	205	130	89	62	50	41	34	30	27	24	22	20	18	16	12	0
1.5	7	8	10	14	15	16	18	20	22	25	29	34	45	101	220	339	375	320	234	151	80	53	40	34	33	27	24	21	19	17	12	2
2.0	6	6	7	9	9	10	11	12	13	15	16	18	23	25	27	72	150	252	336	312	216	109	58	42	34	30	27	24	20	18	13	8
2.5	3	4	5	6	7	7	8	8	9	10	11	12	13	16	19	25	39	75	142	262	309	229	108	58	41	34	30	27	22	19	16	11
3.0	1	2	3	4	4	5	5	6	6	7	7	8	8	10	12	14	17	22	31	76	169	200	236	122	64	43	35	30	24	20	16	11
IA/P = 0.30														* * * TC = 0.1 HR * * *															IA/P = 0.30			
0.0	0	0	0	154	568	536	526	217	172	149	126	107	97	86	76	69	63	58	53	48	46	42	38	34	31	30	28	27	24	20	19	0
.10	0	0	6	19	109	415	742	603	346	230	176	143	119	96	84	74	68	62	57	50	47	44	40	35	32	30	29	27	24	21	19	0
.20	0	0	0	0	13	77	362	609	605	432	297	217	167	115	94	81	73	66	60	53	48	45	41	37	33	31	29	29	25	21	19	0
.30	0	0	0	0	9	54	219	479	563	476	357	263	169	129	99	85	75	68	62	56	49	45	41	37	33	31	29	25	25	21	19	0
.40	0	0	0	0	0	6	38	159	372	500	484	399	309	183	123	96	82	73	66	58	51	46	42	38	34	31	30	28	25	22	19	0
.50	0	0	6	0	0	4	27	115	287	429	465	421	344	213	138	103	86	76	68	59	52	47	43	39	34	32	30	29	25	22	19	0
.75	0	0	0	0	0	0	1	10	46	132	246	338	381	341	243	165	119	94	80	67	58	50	45	41	37	33	31	29	26	23	19	0
1.0	0	0	0	0	0	0	0	1	4	22	69	149	241	357	331	246	170	122	96	76	64	54	47	42	38	34	32	30	27	24	19	0
1.5	0	0	0	0	0	0	0	0	0	0	0	1	6	41	142	254	310	285	224	142	97	71	55	47	43	39	35	32	29	25	20	4
2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	49	130	221	279	255	182	108	70	55	47	42	38	34	30	27	20	11
2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	14	52	119	224	256	193	107	70	55	47	42	38	32	28	22	17
3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9	52	161	240	199	117	74	56	48	43	35	30	24	18
IA/P = 0.50														* * * TC = 0.1 HR * * *															IA/P = 0.50			
0.0	0	0	0	0	70	539	377	196	171	154	136	117	108	99	89	83	77	72	67	61	59	56	51	46	43	42	40	38	34	30	28	0
.10	0	0	0	0	47	375	376	256	199	169	146	126	114	102	92	85	79	73	68	62	59	56	52	47	43	42	40	38	34	30	28	0
.20	0	0	0	0	0	31	260	338	283	227	189	160	138	112	99	90	83	77	72	66	60	57	53	48	44	42	41	39	35	30	29	0
.30	0	0	0	0	0	0	21	100	285	284	246	208	176	131	110	97	88	82	76	68	62	59	54	50	45	43	41	39	36	31	28	0
.40	0	0	0	0	0	0	14	125	232	266	253	223	162	142	115	100	91	83	77	69	63	59	55	50	45	43	41	40	36	31	28	0
.50	0	0	0	0	0	0	9	86	183	239	248	231	205	154	122	104	93	85	79	71	64	59	55	51	46	43	41	40	36	32	29	0
.75	0	0	0	0	0	0	3	31	87	147	190	211	213	184	147	121	103	92	84	75	67	61	57	52	47	44	42	40	37	32	28	0
1.0	0	0	0	0	0	0	0	0	1	13	45	92	141	205	167	165	134	112	98	84	75	65	[illegible]	55	50	46	43	41	38	34	28	0
1.5	0	0	0	0	0	0	0	0	0	0	0	2	9	51	118	170	183	167	143	111	92	77	65	59	54	50	45	43	39	35	28	2
2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15	51	103	148	168	156	127	96	76	65	58	54	49	45	41	37	29	12
2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9	31	69	131	159	140	101	78	66	59	54	50	43	39	31	24
3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	11	45	101	151	134	99	77	65	59	54	45	41	33	26

RAINFALL TYPE = II   * * * TC = 0.1 HR * * *   SHEET 1 OF 10

REF. URBAN HYDROLOGY FOR SMALL WATERS!

17

Des Urban Hydrology for Small Watrsd

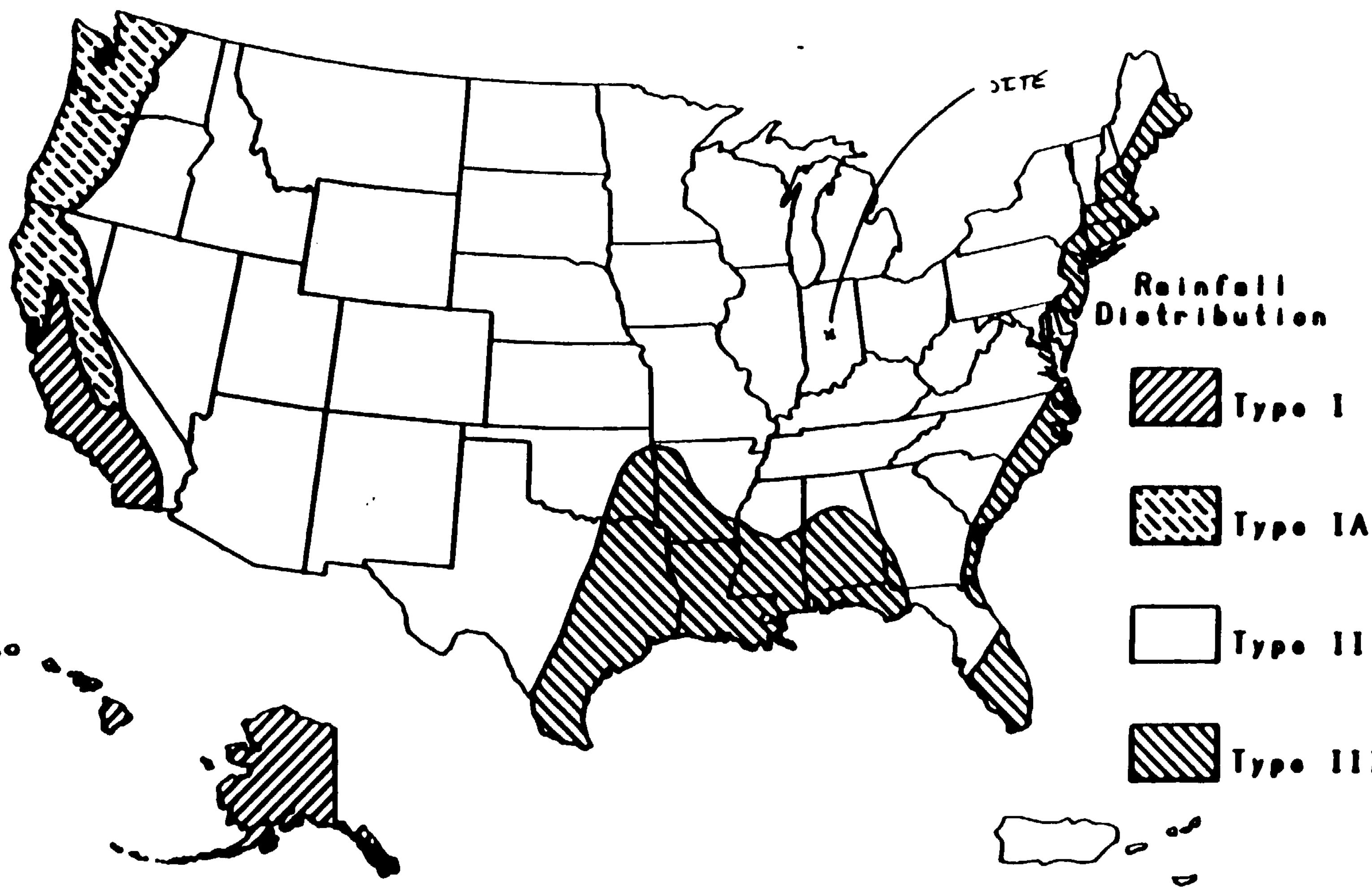

Figure B-2.—Approximate geographic boundaries for SCS rainfall distributions.

1927/29

TABLE XIV.—Values of Effective Absolute Roughness and Friction Formula Coefficients

Conduit Material	Effective Absolute Roughness (Darcy-Weisbach) k (ft)	Manning n (ft)	Hazen-Williams C*
Closed conduits			
Asbestos-cement pipe	0.001–0.01	0.011–0.015	100–140
Brick	0.005–0.02	0.013–0.017	—
Cast iron pipe			
Uncoated (new)	0.00085	—	—
Asphalt dipped (new)	0.0004	—	—
Cement-lined & seal coated	0.001–0.01	0.011–0.015	100–140
Concrete (monolithic)			
Smooth forms	0.001–0.005	0.012–0.014	—
Rough forms	0.005–0.02	0.015–0.017	—
Concrete pipe	0.001–0.01	$\boxed{0.011–0.015}$	100–140
Corrugated-metal pipe (½-in. × 2⅔-in. corrugations)			
Plain	0.1 –0.2	0.022–0.026	—
Paved invert	0.03 –0.1	0.018–0.022	—
Spun asphalt lined	0.001–0.01	0.011–0.015	100–140
Plastic pipe (smooth)	0.01	0.011–0.015	100–140
Vitrified clay			
Pipes	0.001–0.01	0.011–0.015	100–140
Liner plates	0.005–0.01	0.013–0.017	—
Open channels			
Lined channels			
a. Asphalt	—	0.013–0.017	—
b. Brick	—	0.012–0.018	—
c. Concrete	0.001–0.03	0.011–0.020	—
d. Rubble or riprap	0.02	0.020–0.035	—
e. Vegetal	—	0.030–0.40 *	—
Excavated or dredged			
Earth, straight and uniform	0.01	0.020–0.030	—
Earth, winding, fairly uniform	—	0.025–0.040	—
Rock	—	0.030–0.045	—
Unmaintained	—	0.050–0.14	—
Natural channels (minor streams, top width at flood stage < 100 ft)	0.1 –3.0	—	—
Fairly regular section	—	0.03 –0.07	—
Irregular section with pools	—	0.04 –0.10	—

* Assume dimensional units contained in 1.32 term in formula. See References (2) (19)(20). (Varies with depth and velocity.)

the values obtained in laboratory tests with clear water and clean conduits.

The range in coefficients for a given pipe material is explained partially by the disturbing influences mentioned previously in the general discussion of coefficients. A coefficient which will yield higher friction losses should be selected for sewers with high disturbing influences.

Because of the physical and hydraulic conditions which may influence a friction formula coefficient, the values given in Table XIV for one fric-

Design and Construction of Sanitary and Storm Sew

CALCULATION NUMBER 6.0

SHEET PILE CUTOFF WALL

CALCULATION WORKSHEET

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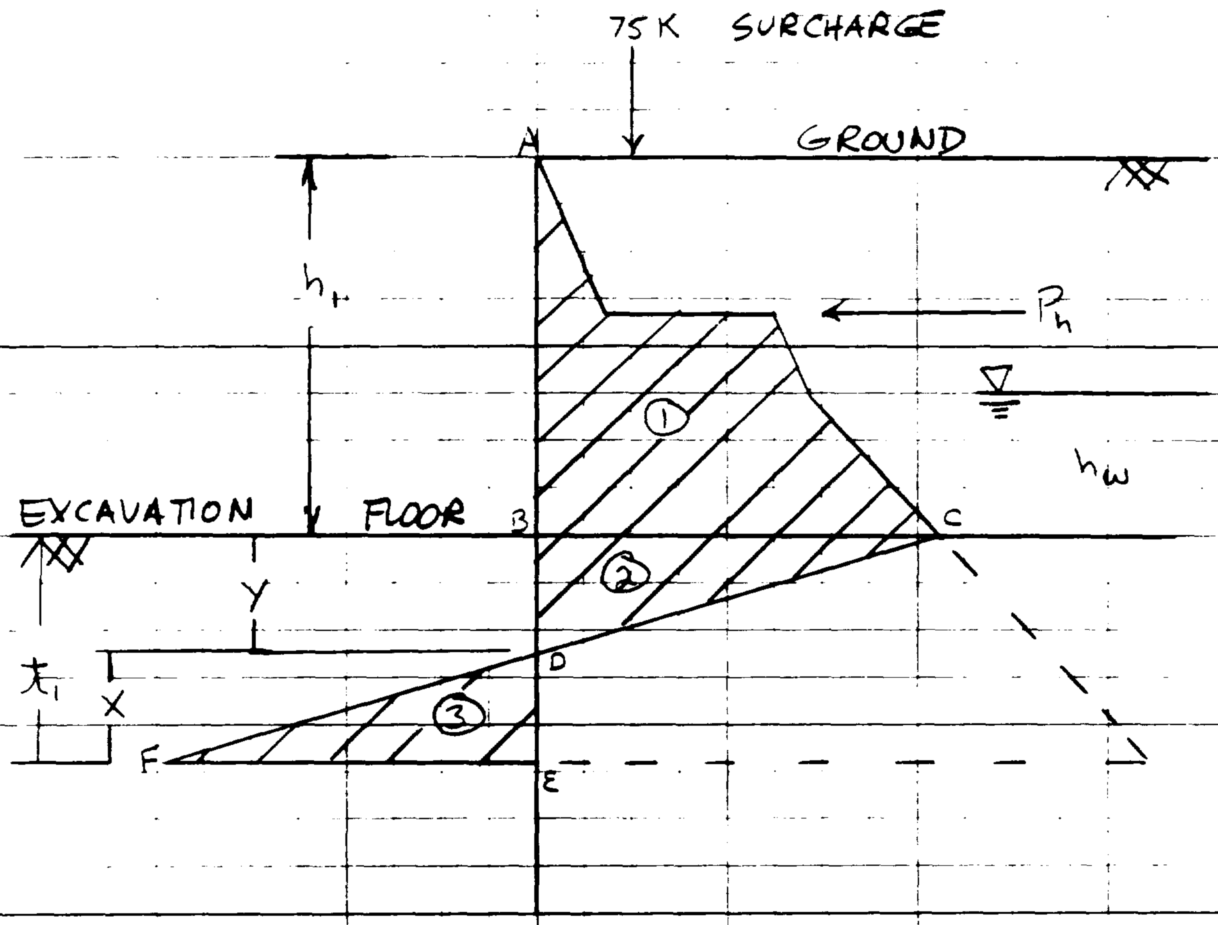
SUBJECT: Sheet Pile Wall Calcs		CHECKED BY:	DATE:

CALCULATION № 6

SHEET PILE CUTOFF WALL



Assume embedment in Silty Clay (ML-CL)

Assume Pile depth =	23.5		
t1 =	17		
Layer number	1	2	Water
Depth of layer (h)	9	17.04	3.5
Phi (degrees)	28	32	
Density of layer (d)	120	120	62.4

From "Civil Engineering Reference Manual, Sixth Edition", Lindbergh 1992, page10-16

Ka of layer	0.36	0.31
Kp of layer	2.78	3.23

Point surcharge Q= 75,000 lb at 4 ft from face of wall

Calculation of resultant load on sheet pile from surcharge Q

From Figure b, (see page 7)

m =x(dist from face)/H(height of face) = 0.44

From Figure d, (see page 7)

theta = H^2/Q(in kips) = 1.08

From nomograph n= 0.47

From "Civil Engineering Reference Manual, Sixth Edition", Lindbergh 1992, page10-17

$Ph=1.77Q/H*(m^2n^2/(m^2+n^2)^3)$

Ph=	1.77Q/H	m^2n^2	$(m^2+n^2)^3$
	1.64	0.04	0.07

Ph = 0.94 kips = 940 pounds

since n=y/h, y = 0.47 X 9 = 4.2 feet from top

Ph acts at dh = 4.8 feet from bottom

Pc = (d1Xh1XKa1)+(dw*hw)+Ph

Pc = 1547.2 psf per foot of wall

y = Pc/(d2X(Kp2-Ka2))

y = 4.42 feet below dredgeline

Pf = (d2Xh2XKp2)-(Pc+(d2Xh2XKa2))

Pf = 4423.62 psf per foot of wall

Sum Me = -1159.88 Pile length is OK

Calculation of point on Shear (V) = 0

P1 = 3071.8

P2 = 3419.31

P3 = $0.5X(x^2)X(d2)(Kp2-Ka2)+0.5X(x^2)X(dw)$ = 206.4 x^2, and since P3=P1+P2

x^2 = 31.45 sf

x = 5.61 ft = point below dredgeline where V=0

Calculation of maximum moment (Mm) at point where V=0

P1L1 = 41016.85 lb-ft

Subject: Sheet Pile Wall Calcs Checked:_____ Date: __________

P2L2 =	29257.91 lb-ft	
P3L3 =	-23203.4 lb-ft	
Mmax =	47071.32 lb-ft =	564855.8 lb-in

Assuming f_s = 25000 is the allowable stress for ASTM 328 steel
Required section modulus (S) = Mmax/f_s
S= 22.59 cubic inches

Therefore XZ 85 sheet pile with S=30.2 in^3/ft > 22.59 in^3 is recommended

Assume embedment in Sand/Some Gravel (SP)

Assume Pile depth =	21		
t1 =	15.2		

Layer number	1	2	Water
Depth of layer (h)	9	15.23	3.5
Phi (degrees)	28	37	
Density of layer (d)	120	100	62.4

From "Civil Engineering Reference Manual, Sixth Edition", Lindbergh 1992, page10-16

Ka of layer	0.36	0.25
Kp of layer	2.78	4

Point surcharge Q= 75,000 lb at 4 ft from face of wall

Calculation of resultant load on sheet pile from surcharge Q

From Figure b, (see page 7)

m =x(dist from face)/H(height of face) = 0.44

From Figure d, (see page 7)

theta = H^2/Q(in kips) = 1.08

From nomograph n= 0.47

From "Civil Engineering Reference Manual, Sixth Edition", Lindbergh 1992, page10-17

$Ph=1.77Q/H*(m^2n^2/(m^2+n^2)^3)$

Ph=	1.77Q/H	m^2n^2	$(m^2+n^2)^3$
	1.64	0.04	0.07

Ph = 0.94 kips = 940 pounds

since n=y/h, y = 0.47 X 9 = 4.2 feet from top

Ph acts at dh = 4.8 feet from bottom

Pc = (d1Xh1XKa1)+(dw*hw)+Ph

Pc = 1547.2 psf per foot of wall

y = Pc/(d2X(Kp2-Ka2))

y = 3.44 feet below dredgeline

Pf = (d2Xh2XKp2)-(Pc+(d2Xh2XKa2))

Pf = 4164.05 psf per foot of wall

Sum Me = -1683.12 Pile length is OK

Calculation of point on Shear (V) = 0

P1 = 3071.8

P2 = 2661.18

P3 = 0.5X(x^2)X(d2)(Kp2-Ka2)+0.5X(x^2)X(dw) = 218.7 x^2, and since P3=P1+P2

x^2 = 26.21 sf

x = 5.12 ft = point below dredgeline where V=0

Calculation of maximum moment (Mm) at point where V=0

P1L1 = 36501.31 lb-ft

P2L2 =	19728.24 lb-ft	
P3L3 =	-18193 lb-ft	
Mmax =	38036.54 lb-ft =	456438.5 lb-in

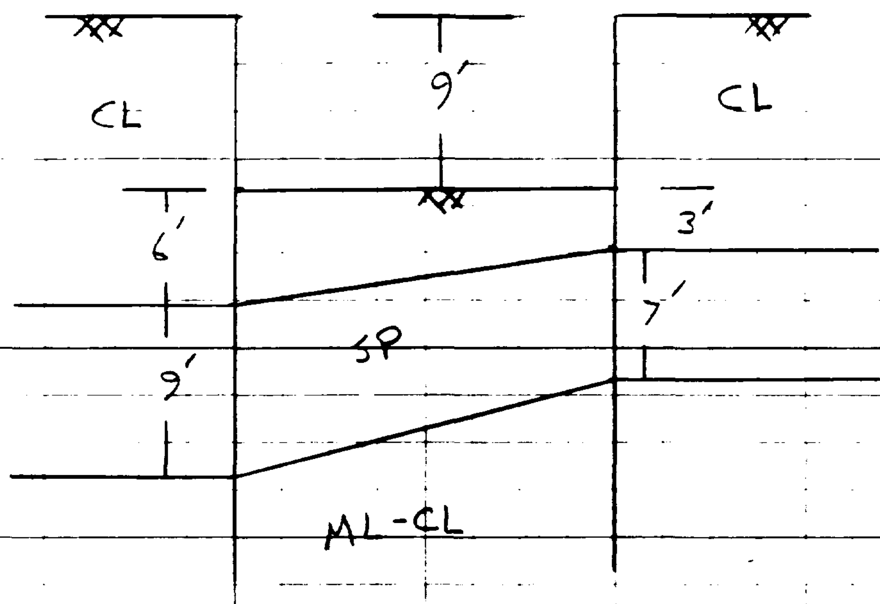
Assuming f_s = 25000 is the allowable stress for ASTM 328 steel
Required section modulus (S) = Mmax/f_s
S= 18.26 cubic inches

Therefore XZ 85 sheet pile with S=30.2 in^3/ft > 22.59 in^3 is recommended

CALCULATION WORKSHEET

CLIENT: ECC	FILE NO.: 2455	BY: JRE	PAGE 5 OF 10
SUBJECT: Sheet Pile Wall Calcs		CHECKED BY:	DATE:

Geology of Excavation Area



Pile embedment of 23.5 feet as calculated for silty clay [illegible] is conservative. The presence of sand within the passive resistance zone will increase the FS for this length.

Additionally, the length of 23.5 feet will be sufficient to cutoff the water bearing sands which occur between 3 and 15 feet below the excavation bottom.

C. COHESIONLESS SAND ($c = 0$)

The maximum slope angle for cohesionless sand is the angle of internal friction, ϕ.

23 EARTH PRESSURE THEORIES

The general equation for horizontal *active earth pressure* is:

$$p_{\text{horizontal}} = p_{\text{vertical}} \tan^2\left(45° - \frac{\phi}{2}\right) - 2c\tan\left(45° - \frac{\phi}{2}\right) \quad 10.51$$

c in equation 10.51 is the soil's cohesion.

p_{vertical} can be due to surcharge, externally applied loads, or the soil's own mass.

If $\phi = 0°$, as in the limiting case for saturated clay, then

$$p_{\text{horizontal}} = p_{\text{vertical}} - 2c \quad 10.52$$

If $c = 0$, as in the limiting case for drained sand,

$$p_{\text{horizontal}} = p_{\text{vertical}}\left[\tan^2\left(45° - \frac{\phi}{2}\right)\right] \quad 10.53$$

The quantity in brackets in equation 10.53 is known as the *coefficient of active earth pressure.*

$$k_A = \tan^2\left(45° - \frac{\phi}{2}\right) = \frac{1 - \sin\phi}{1 + \sin\phi} \quad 10.54$$

The general equation for horizontal *passive earth pressure* is:

$$p_{\text{horizontal}} = p_{\text{vertical}} \tan^2\left(45° + \frac{\phi}{2}\right) + 2c\tan\left(45° + \frac{\phi}{2}\right) \quad 10.55$$

The *coefficient of passive earth pressure* for sand is

$$k_P = \frac{1}{k_A} = \tan^2\left(45° + \frac{\phi}{2}\right) = \frac{1 + \sin\phi}{1 - \sin\phi} \quad 10.56$$

A. THE RANKINE THEORY

If it is assumed that the backfill soil is dry, cohesionless sand, then the *Rankine theory* can be used. At any depth, H, the vertical pressure is

$$p_{\text{vertical}} = \rho H \quad 10.57$$

The horizontal pressure depends on the *coefficient of earth pressure at rest*, k_o, which varies from 0.4 to 0.5 for untamped sand.[18]

$$p_{\text{horizontal}} = k_o \rho H \quad 10.58$$

$$k_0 \approx 1 - \sin\phi \quad 10.59$$

$$R_o = \tfrac{1}{2} k_o \rho H^2$$

Equations 10.57 and 10.58 apply only to a sand deposit of infinite depth and extent. For sand that is compressed or tensioned (as in around a retaining wall) the reactions are given by equations 10.60 and 10.61.

$$R_A = (p_{\text{horizontal}})\left(\frac{H}{2}\right) = \frac{1}{2} k_A \rho H^2 \quad 10.60$$

$$R_P = \frac{1}{2} k_P \rho H^2 \quad 10.61$$

R_A and R_P are horizontal if the soil above the heel and toe is horizontal. (See figure 10.19.)

B. WEDGE THEORIES

The Rankine theory is based on infinite, cohesionless soil. It also requires that the soil above the heel be level. Modifications can be made to lift these restrictions, as well as to allow a water table above the foundation base. Several modifications are known as *wedge theories*. *Coulomb's earth-pressure theory* is one such wedge theory.

The wedge methods are based on the observation that retaining walls fail when the active soil shears. Although the shear plane is actually a slightly curved surface, it is assumed to be linear (line *–* in figure 10.15). However, since the actual shear plane is not known in advance, several trial planes need to be taken. This is known as the *trial wedge method*.

24 SLOPED AND BROKEN SLOPE BACKFILL

It is possible to derive equations for the active force with a sloped backfill, as shown in figure 10.16. However, the complexity of these equations usually makes a graphical solution a better choice.

With sloped or broken slope backfill, the active force is not horizontal. Appendix A and appendix B provide a method of evaluating the horizontal and vertical earth pressure. Notice that k_h and k_v have units of lbf/ft^2 per foot of wall. Soil density is not used.

$$R_{A,h} = \frac{1}{2} k_h H^2 \quad 10.62$$

$$R_{A,v} = \frac{1}{2} k_v H^2 \quad 10.63$$

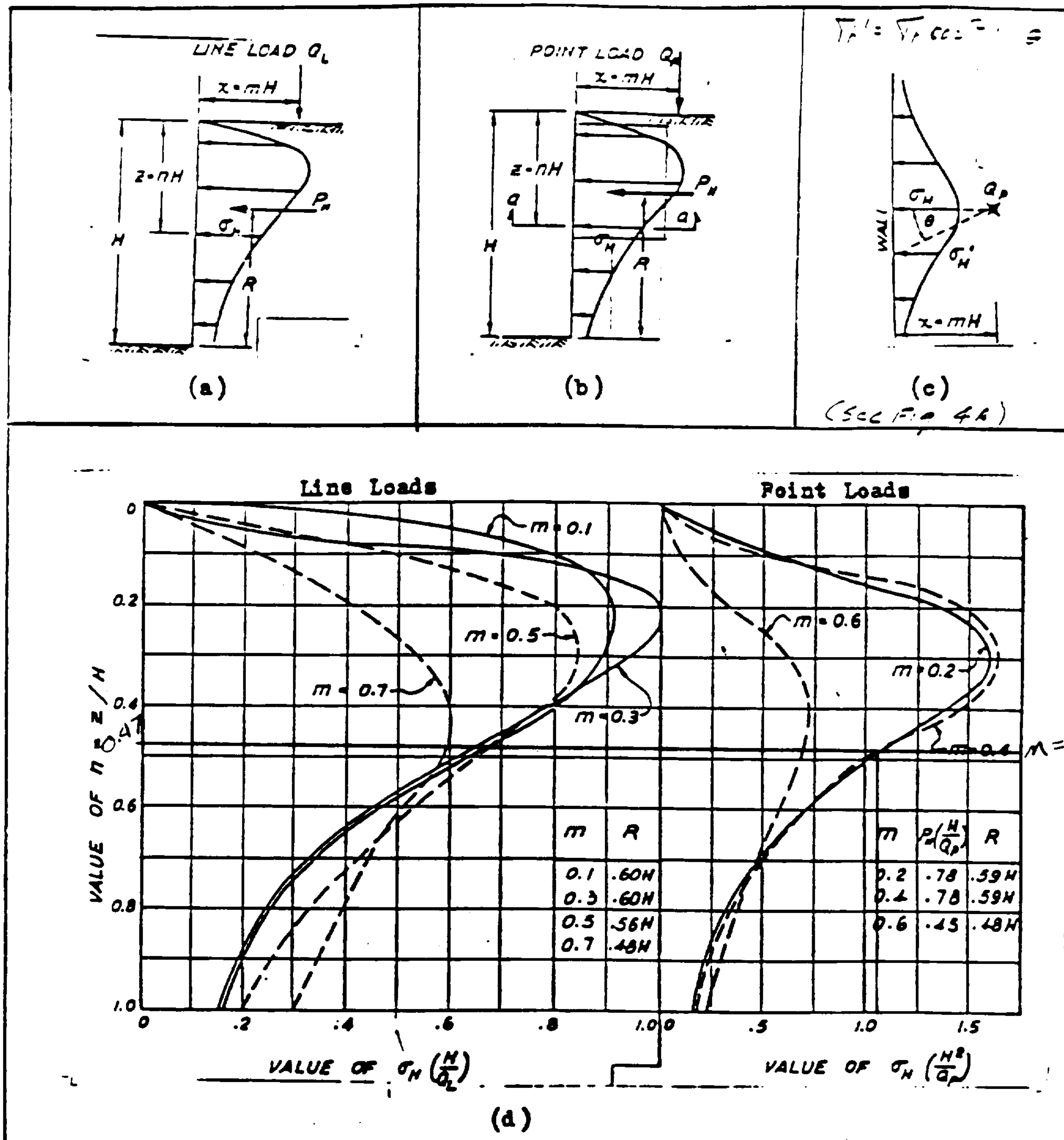
[18] It is appropriate to use the at-rest soil case whenever the wall does not move. Bridge abutments and basement walls are examples where movement is essentially nonexistent.

$P_h = 0.55\ Q_L$ for $m \leq 0.4$

$P_h = \left[0.64\ Q_L/(m^2 + 1)\right]$ for $m > 0.4$

$P_h = 0.78(Q_p/H)$ for $m \leq 0.4$

$P_h = 0.45(Q_p/H)$ for $m > 0.6$



m	R
0.1	.60H
0.3	.60H
0.5	.56H
0.7	.48H

m	$P_H(H/Q_p)$	R
0.2	.78	.59H
0.4	.78	.59H
0.6	.45	.48H

Fig. 4 - Lateral earth pressures on walls due to line and point loads, based on the Boussinesq equations modified by experiment. (a) Distribution from line load Q_L (b) Distribution from point load Q_p, elevation view (c) Distribution from point load Q_p, plan view (d) Parameters n and m (After Terzaghi, 1954 7; from NAVFAC, 1982, 3)

7

$$R_A = \sqrt{R_h^2 + R_v^2} \quad 10.64$$

$$\theta = \arctan\left(\frac{R_v}{R_h}\right) = \beta \quad 10.65$$

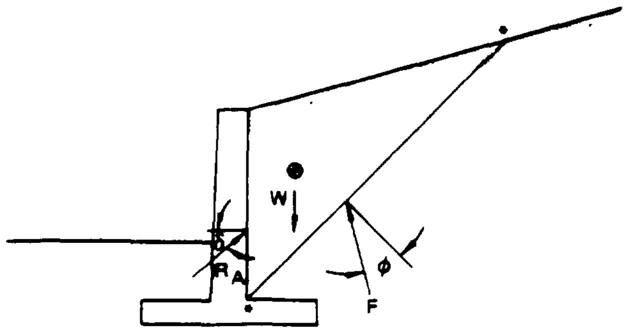


Figure 10.15 Failure Wedge

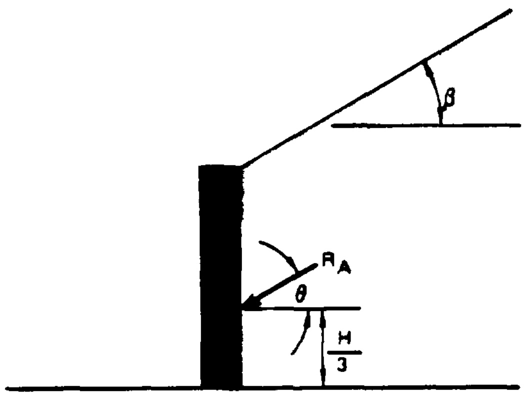


Figure 10.16 Sloped Backfill

25 SURCHARGE LOADING

A. UNIFORM SURCHARGE

If there is a uniform surcharge load of q lbf/ft^2 above the backfill, there will be an additional active reaction, R_q. R_q acts at $H/2$ above the base. This reaction is in addition to the regular active reaction which acts at $H/3$.

$$R_q = k_A q H \times \text{wall width} \quad 10.66$$

B. POINT LOAD

If a point load is applied a distance x back from the wall face, as in figure 10.18, the distribution of pressure behind the wall can be found from equations 10.67 through 10.70.[19]

[19] These equations are based on elastic theories with a Poisson's ratio of $\mu = 0.5$. The coefficients have been adjusted to bring the theory into agreement with observed values.

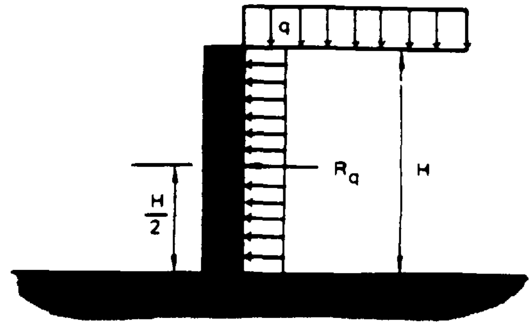


Figure 10.17 A Uniform Surcharge

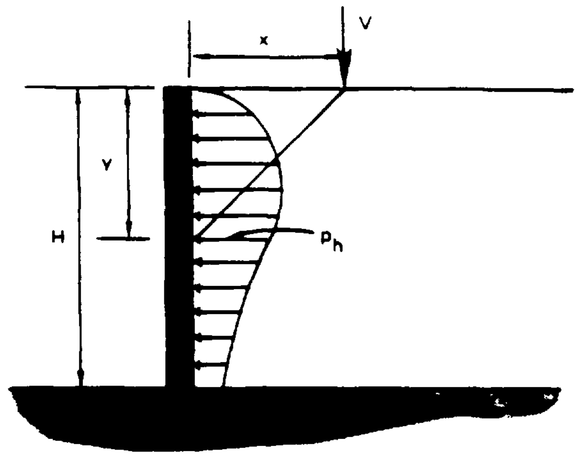


Figure 10.18 A Point Load Distribution

$$m = \frac{x}{H} \quad 10.67$$

$$n = \frac{y}{H} \quad 10.68$$

$$p_h = \frac{1.77V}{H^2}\frac{m^2n^2}{(m^2+n^2)^3} \quad (m > 0.4) \quad 10.69$$

$$p_h = \frac{0.28V}{H^2}\frac{n^2}{(0.16+n^2)^3} \quad (m \le 0.4) \quad 10.70$$

C. LINE LOAD

For a line load of q lbf/ft, the distribution of pressure behind the wall is given by equations 10.71 and 10.72. Figure 10.18 applies if V is replaced with q.

$$p_h = \frac{4}{\pi}\frac{q}{H}\left(\frac{m^2n}{(m^2+n^2)^2}\right) \quad (m > 0.4) \quad 10.71$$

$$p_h = \frac{q}{H}\frac{0.203n}{(0.16+n^2)^2} \quad (m \le 0.4) \quad 10.72$$

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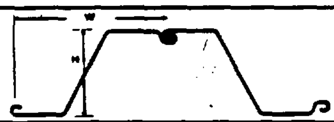
Section	Thickness in (mm)	Height in (mm)	Nominal Width in (mm)	Section Area in² (cm²)	Weight lbs/lin ft. (kg/lin m)	Weight lbs/ft² (kg/m²)	Moment of Inertia in⁴/wall ft (cm⁴/wall m)	Radius of Gyration in (mm)	Section Modulus in³/wall ft (cm³/wall m)
L27	.106 (2.7)	4.08 (104)	19.7 (500)	2.84 (18.3)	9.91 (14.7)	6.04 (29.4)	4.70 (643)	1.64 (41.9)	2.22 (119)
L34	.134 (3.4)	4.10 (104)	19.7 (500)	3.58 (23.1)	12.5 (18.6)	7.62 (37.2)	5.89 (806)	1.64 (41.9)	2.77 (149)
L41	.164 (4.1)	4.12 (105)	19.7 (500)	4.39 (28.3)	15.0 (22.4)	9.17 (44.7)	7.02 (961)	1.64 (41.9)	3.30 (178)
L45	.177 (4.5)	4.13 (105)	19.7 (500)	4.74 (30.6)	16.2 (24.1)	9.90 (48.1)	7.69 (1050)	1.64 (41.9)	3.62 (195)
L50	.197 (5.0)	4.15 (106)	19.7 (500)	5.29 (34.1)	18.9 (28.2)	11.5 (56.3)	9.82 1340)	1.74 (44.2)	4.14 (223)
L60	236 (6.0)	4.18 (106)	19.7 (500)	6.37 (41.1)	22.3 (33.1)	13.6 (66.1)	11.8 (1610)	1.74 (44.2)	4.97 (268)
L65	.256 (6.5)	4.20 (107)	19.7 (500)	6.90 (44.5)	24.1 (35.8)	14.7 (71.6)	12.8 (1750)	1.74 (44.2)	5.38 (290)

"Z" SERIES

Section	Thickness in (mm)	Height in (mm)	Nominal Width in (mm)	Section Area in² (cm²)	Weight lbs/lin ft. (kg/lin m)	Weight lbs/ft² (kg/m²)	Moment of Inertia in⁴/wall ft (cm⁴/wall m)	Radius of Gyration in (mm)	Section Modulus in³/wall ft (cm³/wall m)
Z55	.217 (5.50)	8.09 (206)	22.0 (559)	7.27 (46.9)	25.0 (37.1)	13.6 (65.5)	45.7 (6250)	3.39 (86.1)	11.4 (614)
Z60	.236 (6.00)	8.11 (206)	22.0 (559)	7.93 (51.1)	27.2 (40.4)	14.8 (71.5)	49.9 (6830)	3.40 (86.4)	12.4 (668)
Z65	.256 (6.50)	8.13 (207)	22.0 (559)	8.59 (55.4)	29.2 (43.3)	16.0 (77.4)	54.1 (7400)	3.41 (86.6)	13.4 (722)
Z70	.276 (7.00)	8.15 (207)	22.0 (559)	9.25 (59.7)	31.5 (46.7)	17.2 (83.7)	58.6 (8020)	3.42 (86.9)	14.4 (775)
Z75	.295 (7.50)	8.17 (208)	22.0 (559)	9.90 (63.9)	33.7 (50.0)	18.4 (89.5)	63.9 (8750)	3.44 (87.4)	15.6 (840)

"XZ" SERIES



Section	Thickness in (mm)	Height in (mm)	Nominal Width in (mm)	Section Area in² (cm²)	Weight lbs/lin ft. (kg/lin m)	Weight lbs/ft² (kg/m²)	Moment of Inertia in⁴/wall ft (cm⁴/wall m)	Radius of Gyration in (mm)	Section Modulus in³/wall ft (cm³/wall m)
XZ85	.335 (8.50)	14.06 (357)	25.0 (635)	13.6 (87.6)	46.4 (69.0)	22.3 (109)	212 (29000)	5.70 (145)	30.2 (1630)
XZ90	.354 (9.00)	14.09 (358)	25.0 (635)	14.4 (92.7)	48.9 (72.7)	23.5 (115)	225 (30800)	5.70 (145)	31.8 (1710)
XZ95	.375 (9.50)	14.12 (359)	25.0 (635)	15.2 (98.2)	51.7 (76.9)	24.8 (121)	237 (32400)	5.70 (145)	33.5 (1800)
XZ100	.394 (10.0)	14.15 (360)	25.0 (635)	15.9 (103.0)	54.2 (80.7)	26.0 (127)	250 (34200)	5.71 (145)	35.3 (1900)

INTERNATIONAL CONSTRUCTION SERVICES, INC.
P.O. Box 15598 Phone: (412) 788-6430
Pittsburgh, PA 15244 Fax: (412) 788-9180

REVISED REMEDIAL ACTION FINAL DESIGN

DRAINAGE CALCULATIONS - WATERSHED AREAS

ENVIRO-CHEM SUPERFUND SITE — ZIONSVILLE, INDIANA

CLIENT:	ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION TRUST	JOB NO.	2455 - 006
SCALE:	1" = 30'	DRAWING NUMBER	WS1
REV			

APPENDIX B

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

REVISED REMEDIAL ACTION
FINAL (100 PERCENT) DESIGN REPORT

ENVIRO-CHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

Prepared for:
Environmental Conservation and
Chemical Corporation Site Trust Fund

Radian Project No. 002455.06

June, 1997

RADIAN
INTERNATIONAL LLC

TECHNICIAL SPECIFICATIONS
REVISED REMEDIAL ACTION
FINAL (100 PERCENT) DESIGN REPORT

ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION SUPERFUND SITE

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RADIAN INTERNATIONAL LLC

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NOTICE

This document is a portion of the overall design package and, therefore, cannot be referenced, in whole or in part, as a standalone document for any other purpose.

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.01 SCOPE

A. This section includes a brief description of the major components covered under this contract. The scope of work includes both construction and operation of the remedial action. A more complete description of the work is provided in individual sections of these Specifications and on the Drawings. The Contractor shall furnish all equipment, labor, materials, health and safety, quality control services, and execution of all work necessary to complete the work for final acceptance as outlined in the Remedial Construction Plan and achieve soil cleanup as described in Section 13210 - SITE OPERATIONS AND MAINTENANCE.

1.02 GENERAL REQUIREMENTS

A. As minimum requirements, the Contractor shall observe and comply with all applicable Federal, state, and local laws, rules and regulations in conducting the work. The Contractor shall be responsible for contacting and informing the proper Federal, state, and local agencies of the nature and timing of work activities and for securing all necessary and applicable permits required to perform the work covered by this contract.

B. The Contractor shall protect utility lines and/or appurtenances. It is the Contractor's responsibility to locate existing utilities onsite. Any damage shall be repaired by the Contractor at no expense to the Environmental Conservation and Chemical Corporation Trust (ECC Trust).

C. Materials and equipment shall be adequate in capacity for the required usage, must not create unsafe conditions, and shall meet the requirements of all applicable codes and standards.

1.03 DESCRIPTION OF WORK

A. The following work is included in this contract:

1. Soil Vapor Extraction (SVE) System Design: The contractor shall prepare a submittal for the ECC Trust review consisting of construction drawings, specifications and supporting calculations for final design of the SVE System.

2. Temporary Site Facilities: Providing and maintaining temporary site facilities during the performance of this contract such as office trailers, security and communication operations, and the personnel decontamination facility. At the completion of the construction work, all temporary site facilities shall be removed from the Site, except those that are required during the operations phase.

3. Utilities: Providing, operating, and maintaining all site utilities including telephone, electricity, clean water, and sanitation.

4. Site Plans: The Contractor shall prepare and implement a Construction Quality Control Plan (CQCP), a Contractor Health and Safety Plan (CHSP), a Contractor Site Management Plan (CSMP), a Soil Vapor Extraction (SVE) System Start-Up Plan, and a Site Operations and Maintenance Manual for use during construction and implementation of the remedial action. The Contractor shall also be responsible for adherence to the Field Sampling Plan, Quality Assurance Project Plan, Construction Quality Assurance Plan, Site Management Plan, and Air Monitoring Plan for preparation of plans and performance of the work.

5. Pressure-Grout the existing 20-foot by 20-foot by 12 feet deep sump (i.e., the ECC sump) located in the concrete pad area. The grouted interval will be from the floor of the excavation to the bottom of the sump.

6. Crush the southern concrete pad into pieces with a maximum dimension of 3 inches, and place the crushed concrete along with the aggregate subbase in a segregated treatment zone in the northern end of the site. The concrete pads and subbase aggregate at the former process building and at the former entrance road to the facility shall also be removed, crushed, and combined with the crushed southern concrete pad for SVE treatment.

7. Install a sheet pile cutoff wall in the southern concrete pad area and dewater the sand water-bearing zone.

8. Excavate the southern concrete pad subsoils to a minimum depth of 9 feet below the top of concrete. Perform additional soil excavation, if necessary, based on exit soil sampling. Place the soils in the northern fill area and install the Stage 1 cap.

9. Construct onsite wastewater storage tanks, an activated carbon wastewater treatment system, and a water transfer system.

10. Water collected in the ECC sump and the excavation shall be pumped to onsite wastewater storage facilities and will either be disposed of offsite or treated onsite and discharged in accordance with applicable Federal, state, and local regulations.

11. Install an HDPE liner between the excavation and the SVE treatment area, and backfill the excavated area with clayey soils from the NSL borrow area or an alternate borrow area.

    Place a 12-inch layer of topsoil on the backfill soils in the excavated area and seed with appropriate vegetation. Capping of the excavation area will be based on the results of exit soil sampling in the excavation.

12. Install the Soil Vapor Extraction Treatment Zone Dewatering System and the Soil Vapor Extraction Treatment System, including the Vapor Treatment System.

13. Install the compliance monitoring wells.

14. Operate the SVE System, including treatment and disposal of wastewater.

15. Perform soil cleanup verification monitoring.

16. Construct the Stage 2 cap after verification of soil cleanup.

17. Demobilization: Remove from the Site of all Contractor equipment, and removal of the temporary facilities. The Contractor shall leave the site security fence and gates, equipment decontamination pad, the wastewater storage pad, and utilities onsite after shutdown of SVE system operations.

18. All other activities to satisfactorily complete all work covered by these Specifications and Drawings not specifically discussed but necessary for the project construction and final acceptance.

19. All other work required by the ECC Trust under the terms of this contract.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01012 - SUMMARY OF SITE CONDITIONS

PART 1 - GENERAL

1.01 SCOPE

A. This section presents a summary of the physical and chemical conditions at the Site encountered during the remedial investigation and subsequent site visits. The Contractor shall make his own determination of the potential hazards at the Site from the information contained herein and from other available information as appropriate. The ECC Trust make no representation or warranty, expressed or implied, as to the accuracy of any information with respect to site conditions. This disclaimer is in addition to, and not in lieu of, any other disclaimers that may appear in the Contract Documents.

1.02 SITE DESCRIPTION AND HISTORY

A. Site Description:

1. The ECC Site is a Federal Superfund Site listed on the National Priorities List (NPL) which is a ranking of hazardous waste sites compiled by the Federal government as part of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

2. The ECC Site is located north of Zionsville Indiana, in Boone County, approximately 10 miles northwest of Indianapolis on State Route 421. The Site occupies about 6.5 acres of land west of the Northside Sanitary Landfill (NSL), an inactive solid waste disposal facility also on the Superfund list. The Site is bounded on the south and east by NSL property, with an unnamed ditch separating the two facilities along the east boundary. The Site is bounded on the west and north by Boone County Resource Recovery Systems, Inc. (BCRRS) property. Several residential homes are located within 1/2 mile of the facility on the north and west sides.

B. History:

1. ECC began site operations in 1977 and was engaged in the recovery, reclamation, and brokering of primary solvents, oils, and other wastes. Waste products were received in drums and bulk tankers and then prepared for subsequent reclamation or disposal. Reclamation processes included distillation, evaporation, and fractionation to reclaim solvents and oil.

2. ECC was placed into receivership in July 1981. Drum shipments to the Site were halted in February 1982, and the Site closed for business in May, 1992. Surface cleanup activities conducted by United States Environmental Protection Agency (U.S. EPA) and Potentially Responsible Party (PRP) contractors during 1983 and 1984 included the removal of cooling pond waters, waste drums, tank waste, contaminated soil, and cooling pond sludge.

3. A site preparation and materials removal action was conducted in 1993. Above-ground structures, tanks and site debris were removed for offsite disposal. A concrete decontamination pad, a lined wastewater storage pad, an aggregate-paved support zone, and a security fence were constructed.

1.03 GENERAL SITE CONDITIONS

A. General site conditions are shown on Contract Drawing G-1.

1.04 SURFACE CONDITIONS

A. General: The site is generally flat and has several concrete pads, building floor slabs, and foundations as shown on the Drawings. A one-foot-thick clay cover has been placed over the contaminated soils within the remedial boundary area.

1.05 SUBSURFACE CONDITIONS

A. Subsurface conditions are described in Attachments A, B and D to the Specifications.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01015 - SEQUENCE OF WORK

Rev. 3, 3/17/97

PART 1 - GENERAL

1.01 GENERAL SEQUENCE OF WORK ACTIVITIES

A. The individual work tasks at the Site shall be conducted in the general sequence indicated in this section. The general sequence includes both concurrent operations and operations that must be completed before or after other construction activities. Except as provided in Part B below, the sequence of work shall not be changed without the prior written approval of the ECC Trust's Engineer (Engineer).

The Contractor is hereby notified that the site support zone and material storage areas are very limited in areal extent as shown on the drawings. Materials and equipment logistical planning and scheduling are critical to successful implementation of the remedial construction.

B. The SVE system construction sequence may vary from the general sequence of work depending on the Final SVE System Design (Second Look) as approved by U.S EPA, IDEM and the Enviro-Chem Trustees. Changes to the general sequence of work shall be approved by the Engineer prior to the Contractor's submittal of the initial progress schedule as described in Specification Section 01310-PROGRESS SCHEDULES AND REPORTS.

C. The following general sequence of work shall be used on the project:

1. Preparation of SVE System Final Design and initial project submittals. (Reference Section 01300) to begin on the first business day after the Trustees give the contractor written notice to proceed with the SVE design. The Contractor will assist the Trustees in negotiating to obtain IDEM and U.S. EPA approval of the SVE design.

2. Site Preparation, to begin five (5) days after the Trustees give the Contractor written notice to proceed with construction:

a. Field surveying.

b. Mobilization of Contractor equipment, personnel, and temporary facilities required for construction activities to the Site.

c. Installation of utilities.

d. Installation of erosion controls onsite and at borrow area and access roads.

e. Install wastewater storage, treatment, and transfer facilities.

f. Perform test borings in southern concrete pad area.

3. Construction[1]

a. Install diversion channels.

b. Grout ECC sump.

c. Prepare onsite fill area.

d. Dewater the southern concrete pad subbase.

e. Remove concrete pads and subbase aggregate, crush concrete, and place materials in onsite fill area.

f. Install sheet pile cutoff walls in the eastern portion of the southern concrete pad area.

g. Dewater the southern concrete pad area sand water-bearing zone within the cutoff walls.

h. Excavate the southern concrete pad area subsoils within the cutoff wall and place them in the onsite fill area (Stage 1).

i. Install an HDPE liner on the north wall of the southern concrete pad excavation within the cutoff wall.

j. Backfill the southern concrete pad area excavation within the cutoff walls (Stage 1 of the excavation as described in Specification Section 02200) and remove the cutoff wall.

---

[1] Construction of the SVE System as referenced in item 3.p. may be in stages and may preceed the steps set forth below depending on the Contractor's approved Final Design.

k. Excavate the southern concrete pad area subsoils in the western pad area and place them in the onsite fill area (Stage 2).

l. Install an HDPE liner on the north wall of the Stage 2 excavation.

m. Backfill the southern concrete pad excavation (Stage 2).

n. Cap the southern concrete pad backfill if required based on exit soil sampling.

o. Cap the northern onsite fill area with the Stage 1 cover.

p. Install the Contractor's approved SVE system including the SVE treatment zone dewatering system (construction may be in several stages and the sequence may vary from that set forth herein based on the contractor's approved Final Design).

q. Install the compliance monitoring wells.

4. Start-Up

a. Start-up the SVE system.

5. Operations

a. Operate the wastewater treatment system (start-up during construction and continue operations through operation of the SVE system).

b. Operate the SVE System, including removal of moisture from within the treatment zone if encountered.

c. Perform the soil cleanup verification monitoring.

d. Place the Stage 2 final cover.

e. Regrade and close the borrow area.

f. Provide maintenance.

6. Demobilization:

   a. Removal of temporary facilities.

   b. Removal of Contractor equipment and personnel from the Site.

   c. The Contractor shall leave the site security fence, equipment decontamination pad, and the wastewater storage pad onsite. The wastewater treatment building and the transfer building shall remain onsite.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01040 - COORDINATION

PART 1 - GENERAL

1.01 SUMMARY

A. The work required by this section shall consist of the Contractor's responsibility to coordinate and communicate project activities with the ECC Trust, the Engineer, all subcontractors, and other parties (e.g., private landowners and Federal, state, and local agencies).

B. The items included under this section are the provision of labor, materials, and equipment and the coordination of the Contractor with all involved parties.

1.02 GENERAL OBLIGATIONS

A. The Contractor shall be responsible for coordinating and communicating with all Federal, state, and local emergency authorities to develop and implement emergency response plans and activities.

B. General obligations of the Contractor shall be as set forth in the Contract Documents. All incidental work and expense in connection with the completion of work under the Contract will be considered a subsidiary obligation of the Contractor, and all such costs shall be considered included in the appropriate items in the Bid Form in connection with which the costs are incurred.

C. The Contractor, any subcontractor, or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, shall cooperate with all firms or persons authorized to perform any work at or adjacent to the project site, and shall assist in incorporating the work of other trades.

1.03 SITE CONDITIONS

A. Drawings show relative locations and approximate sizes and quantities of materials. The Contractor shall verify the accuracy of the Drawings during construction.

B. Site conditions are the Contractor's responsibility. Modifications in the work due to interferences and structural obstructions shall be accomplished as part of the work at no additional cost.

PART 2 - PRODUCTS

2.01 GENERAL

A. The choice of quantity and type of labor, materials, and equipment shall be at the discretion of the Contractor, unless otherwise required by these Specifications, but must be available at the quality and quantity to perform the work required by the Contract Documents and schedule constraints. All substituted materials shall be equivalent to the materials required by these Specifications and shall be approved by the Engineer.

B. The Contractor shall furnish equipment which will be appropriate to secure a satisfactory quality of work and a rate of progress which will ensure the completion of the work within the project schedule. If at any time such equipment appears to the Engineer to be inefficient, inappropriate. or insufficient for achieving the quality of work required or for producing the rate of progress aforesaid, the Engineer may order the Contractor to increase the efficiency, change the character, or increase the equipment, and the Contractor shall conform to such order. Failure of the Engineer to give such an order shall in no way relieve the Contractor of its obligations to achieve the quality of the work and rate of progress required.

PART 3 - EXECUTION

3.01 GENERAL PROCEDURES

A. The Contractor shall not unload or store materials in areas where these actions will interfere with the progress of the project or impede the work onsite.

B. The means and methods of performing the operations, within the constraints detailed in these Specifications, are the sole responsibility of the Contractor.

3.02 PROTECTION OF WORK, PROPERTY AND PERSONS

A. The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work. The Contractor will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage or injury to all employees on the work and other persons who may be affected thereby; all the work and all materials or equipment to be incorporated therein, whether in storage on or off the Site; and other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, buildings, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

B. In emergencies affecting the safety of persons or the work or property at the Site or adjacent thereto, the Contractor, without special instruction or authorization from the Engineer, is obligated to act, at its discretion, to prevent threatened damage, injury, or loss. The Contractor shall give the Engineer written notice of any significant changes in the work or deviations from the Contract Documents caused thereby, and a Change Order shall thereupon be issued, if necessary, to cover the changes and deviations involved. If the Contractor believes that additional work done by it in an emergency which arose from causes beyond its control entitles it to an increase in the Contract Price or an extension of the Contract Time, it may make a claim therefore.

C. If, in the opinion of the Engineer, permanent relocation of a utility, not identified for relocation, is required, the Engineer may direct the Contractor, in writing, to perform the work. If relocation of a publicly owned utility is required, the Contractor will notify the utility to perform the work as expeditiously as possible. The Contractor shall fully cooperate with the utility, and shall have no claim for delay due to such relocation.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01050 - FIELD ENGINEERING AND SURVEYING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes surveying services for accurate location of all features of construction, such as the remedial boundary, diversion channels, sheet pile cutoff wall, excavation limits, fill areas, caps, monitoring wells, and any other features as required by these specifications or as directed by the Engineer.

1.02 QUALITY CONTROL

A. The Contractor is responsible for all the surveying done at the Site. The Surveyor shall be a qualified and Registered Land Surveyor in the State of Indiana. This representative shall also have a minimum of 2 years of experience in construction surveying layout and maintenance of as-built construction drawings with a record of performing horizontal and vertical control requirements as stated in this section. Site survey control points are indicated on the Drawings.

1.03 SUBMITTALS

A. Name, address, Indiana registration number, and telephone number of Surveyor shall be submitted by the Contractor to the Engineer for approval before starting survey work.

B. On request, documentation verifying accuracy of survey work shall be submitted to the Engineer by the Contractor.

C. Certificates signed by the Surveyor stating that elevations and locations of site constructed features are in conformance, or non-conformance, with Contract Documents shall be submitted to the Engineer at the completion of each phase of work requiring services of the Surveyor.

D. Copies of Surveyor's field notes, calculations, and graphical layouts.

E. Certificates signed by the Surveyor stating the accuracy of quantities submitted for payment purposes, as needed for unit price items.

1.04 PROJECT RECORD DOCUMENTS

A. A complete, accurate log of control and survey work as it progresses shall be maintained at work site by the Contractor.

B. Upon completion of the work, all record documents must be submitted to the Engineer.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 INSPECTION

A. The Contractor shall verify locations of site reference and survey control points prior to starting work. The Engineer must be promptly notified of any discrepancies discovered.

3.02 SURVEY REFERENCE POINTS

A. The Engineer will identify to the Contractor all site reference points as shown on the Drawings.

B. The Contractor will take all reasonable measures to protect site references and survey control points prior to starting site work, and must preserve permanent reference points during construction. Site reference points may not be relocated without prior written approval of the Engineer.

C. The Engineer will be immediately notified of loss, damage, or destruction of any reference point, or any relocation required because of changes in grade or other reasons.

D. The Contractor shall establish two permanent elevation benchmarks and two horizontal control points located within and near the perimeter fence in positions unlikely to be disturbed by vehicular traffic or construction operations, one of which shall be near the entrance gate. The other benchmark shall be placed such as to be visible from the first, without obstruction by construction.

The benchmarks and horizontal control points shall be established using the existing control points set by Schneider Engineering or other acceptable reference points approved by the Engineer.

E. Benchmarks shall consist of a 2 ½-inch diameter convex brass plate that is embedded in 8-inch diameter by 36-inch long (minimum) concrete. Brass plate shall have the elevation stamped on it. The top of concrete shall be rounded upward from surrounding soil toward the plate and troweled smooth to shed water.

F. Survey control points shall consist of 5/8-inch diameter rebar at least 30 inches long, encased in 8-inch diameter by 36-inch long (minimum) concrete. Rebar shall project about ½ inch above finished top of concrete. Top of concrete shall be rounded upward from surrounding earth toward the rebar, and troweled smooth to shed water.

G. X, Y, and Z coordinates of benchmarks and survey control points shall be determined and recorded with a maximum permissible error of 0.10 feet in any coordinate direction.

3.03 SURVEY REQUIREMENTS

A. The Contractor shall establish lines and levels, and locate and layout by instrumentation and similar appropriate means, all site features to be constructed.

B. The Contractor will reverify layouts periodically during construction by same means.

3.04 SURVEYS FOR MEASUREMENT AND PAYMENT

A. The Contractor shall perform surveys to determine quantities of all work whose payment is specified to be based on in-place volumes, areas, or lengths.

B. The Contractor's Site Superintendent shall be required to sign the Surveyor's field notes and computations, and shall keep duplicate field notes and computations, and shall certify quantities for payment purposes.

C. Surveys for measurement and payment (including field notes, computations, and results) shall be reviewed and approved by the Engineer.

3.05 REMEDIATION BOUNDARY SURVEY

A. Before initiating construction, the Contractor shall make, by Surveyor, a remediation boundary survey that verifies in the field the exact locations of all boundary corners and angle points, and marks these points as survey control points. The remedial boundary shall include the designed "Line D" as shown on the Drawings.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01210 - PRE-CONSTRUCTION WORK CONFERENCE

PART 1 - GENERAL

1.01 SCOPE

A. This section covers the conferences required after the Notice to Proceed but prior to commencing with construction.

1.02 PRE-CONSTRUCTION WORK CONFERENCE

A. Within 5 working days of receipt of the initial progress schedule pursuant to Specification 01300 and prior to any site work being formed, a Pre-Construction Work Conference will be held between the Contractor, the Engineer, the United States Environmental Protection Agency (U.S. EPA), and the Indiana Department of Environmental Management (IDEM). Attendance by the Contractor's Site Superintendent, quality control personnel, safety personnel, and any major subcontractors will be required.

B. The purpose of this conference is to further define the quality control system and to review the Contractor Quality Control Plan (CQCP). The specifics of the Contractor's other submittals will also be discussed so the emergency procedures and health and safety requirements are understood by all those directly related to the site work. The other Contractor procedures will also be discussed and any required modifications will be explained.

C. At least 3 workings days prior to the Pre-Construction Work Conference, the Contractor shall submit to the Engineer his proposed CQCP. The CQCP will be reviewed to provide an understanding of the quality control system. The Contractor's Progress Schedule will be discussed. Questions concerning administrative requirements or any other aspect of the project may also be addressed.

d. At least 3 working days prior to the Pre-Construction Work Conference, the Contractor shall also submit to the Engineer the following plans for review at the Pre-Construction Work Conference:

1. Contractor Health and Safety Plan.

2. Contractor Site Management Plan.

1.03 CONFERENCE RECORDS

A. The Engineer shall take notes of each conference. Copies of minutes to each participant in each conference shall be distributed. Contractor's shall distribute copies of the minutes to their subcontractors if appropriate.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01220 - PROGRESS MEETINGS

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall attend progress meetings at a minimum of once per week and such additional meetings as required, when scheduled by the Engineer. The meetings shall be on-site in the Engineer's site trailer. The Contractor shall attend these meetings with all necessary personnel. U.S. EPA and IDEM or their designated representatives shall be invited to attend these meetings.

1.02 GENERAL REQUIREMENTS

A. The Engineer shall perform the following for the progress meetings:

1. Prepare agenda for meetings.
2. Make physical arrangements for meetings.
3. Preside at meetings.
4. Record the minutes, including significant proceedings and decisions.
5. Reproduce and distribute copies of minutes after each meeting to participants in the meeting and to parties affected by decisions made at the meeting.

B. Typical Agenda:

1. Review and approval of minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Discussion of field observations, problems, or conflicts.
4. Discussion of problems that impede construction schedule.
5. Review of delivery schedules for limiting equipment and supplies.
6. Discussion of corrective measures and procedures to regain projected schedule.

7. Revision to construction schedule.

8. Review of planned progress during succeeding work period.

9. Coordination of schedules.

10. Review of submittal schedule; expedition as required.

11. Maintenance of quality and safety standards.

12. Discussion of pending design changes and substitutions.

13. Review of proposed changes for effect on construction schedule and on completion date.

14. Review compliance with Health and Safety Plan.

15. Discussion of other business.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide the submittals required by these Specifications for the Engineer's review. Major submittals as indicated shall be provided to the Trustees and the Engineer.

The Engineer will provide copies of all major submittals to the U.S. EPA and IDEM for their information. All other reports listed in Table 01300-1 will be made available promptly for inspection by U.S. EPA, IDEM, and U.S. EPA's consultant.

B. The Soil Vapor Extraction System Final Design required under Specification Section 13100 (also referred to as the "second look" design) shall be submitted to the Trustees and the Engineer for their review prior to submittal to U.S. EPA. The SVE second look design, when approved by the Engineer, will be submitted to the U.S. EPA and IDEM. The Contractor will assist the Trustees and the Engineer in negotiating to obtain IDEM and U.S. EPA approval of the SVE Design.

C. Submittals Summary

The list of Contractor submittals is summarized on Table 01300-1, Contractor Submittals Summary. This summary is subject to change and is not intended as a substitute for the specification requirements nor is it a substitute for the submittals register as required in the Construction Quality Assurance Plan. The summary is provided as a guide to the Contractor in preparation of the project submittals.

TABLE 01300-1
CONTRACTOR SUBMITTALS SUMMARY

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
01050	FIELD ENGINEERING AND SURVEYING	Name, address, Indiana registration number, and telephone number of Surveyor.	Before starting surveying work.
01050	FIELD ENGINEERING AND SURVEYING	Documentation verifying accuracy of survey work.	On request.
01050	FIELD ENGINEERING AND SURVEYING	Certificates signed by the Surveyor stating that elevations and locations of site constructed features are in conformance, or non-conformance, with Contract Documents.	At the completion of each phase of work requiring services of the Surveyor.
01050	FIELD ENGINEERING AND SURVEYING	Copies of Surveyor's field notes, calculations, and graphical layouts.	A minimum of (5) working days in advance of commencing the related work.
01050	FIELD ENGINEERING AND SURVEYING	Certificates signed by the Surveyor stating the accuracy of quantities submitted for payment purposes.	A minimum of (5) working days in advance of commencing the related work.
01050	FIELD ENGINEERING AND SURVEYING	A complete, accurate log of control and survey work as it progresses shall be maintained at work site by the Contractor. Upon completion of the work, all record documents must be submitted to the Engineer.	A minimum of (5) working days in advance of commencing the related work.
01310	PROGRESS SCHEDULES AND REPORTS	Contractor's Initial Progress Schedules and Report.	Within five (5) days after the effective date of the contract.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
01310	PROGRESS SCHEDULES AND REPORTS	Contractor's Monthly Progress Schedules and Reports.	Submit to the Engineer by the 4th day of each month.
01310	PROGRESS SCHEDULES AND REPORTS	Contractor's Revised Progress Schedules and Reports.	Submit to the Engineer by the 10th day of each month.
01310	PROGRESS SCHEDULES AND REPORTS	Contractor's Final Progress Schedules and Reports.	Within (30) days of completion of work.
01380	CONSTRUCTION PHOTOGRAPHS	Color Photographs shall be taken during and prior to the start of construction. (See specifications for photo locations, number of photographic views, quantity, size and type of photographs and slides.)	Delivered to the Engineer as soon as possible. Maximum of (10) days after photos are taken.
01380	CONSTRUCTION PHOTOGRAPHS	Color Photographs shall be taken during and at the completion of Site Preparation. (See specifications for photo locations, number of photographic views, quantity, size and type of photographs and slides.)	Delivered to the Engineer as soon as possible. Maximum of (10) days after photos are taken.
01380	CONSTRUCTION PHOTOGRAPHS	Color Photographs shall be taken during the project work all major work activities at least once per month and at such intervals as necessary to provide complete documentation. (See specifications for photo locations, number of photographic views, quantity, size and type of photographs and slides.)	Delivered to the Engineer as soon as possible. Maximum of (10) days after photos are taken.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
01380	CONSTRUCTION PHOTOGRAPHS	Aerial color photographs of the Site shall be taken from low elevation (See specifications for photo locations, number of photographic views, quantity, size and type of photographs.)	Delivered to the Engineer as soon as possible. Maximum of (10) days after photos are taken.
01385	APPROVALS AND PERMITS	Letter of Commitment from Waste Haulers. (See specifications for information required in letter of commitment.)	Submitted with the Contractor's bid.
01385	APPROVALS AND PERMITS	Letter of Commitment from Hazardous Disposal Facilities. (See specifications for information required in letter of commitment.)	Submitted with the Contractor's bid.
01385	APPROVALS AND PERMITS	Letter of Commitment from Non-Hazardous Disposal Facilities. (See specifications for information required in letter of commitment.)	Submitted with the Contractor's bid.
01385	APPROVALS AND PERMITS	Application for Special Waste. (See specifications, Part 1 - General , 1.03, C)	Submitted with the Contractor's bid.
01390	HEALTH AND SAFETY	Contractor Health and Safety Plan, CHSP (See the specifications for information required in the CHSP.)	At least (3) working days prior to the Pre-construction Conference.
01390	HEALTH AND SAFETY	Contractor's Health and Safety Officer (HSO) name, and qualifications. (See the specifications for information required as part of the HSO's qualifications.)	Submitted with the Contractor's bid.
01390	HEALTH AND SAFETY	Daily Safety Logs. (See the specifications for information required in the Daily Safety Logs.)	Submitted to the Engineer on a daily basis.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
01390	HEALTH AND SAFETY	Training logs. (See the specifications for information required in the Training Logs.)	Submitted to the Engineer on request.
01390	HEALTH AND SAFETY	Air Monitoring Results. (See the specifications for information required in the Air Monitoring Results.)	Submitted to the Engineer on a daily basis.
01390	HEALTH AND SAFETY	Weekly Safety Reports. (See the specifications for information required in the Weekly Safety Reports.)	Submitted to the Engineer on a weekly basis.
01390	HEALTH AND SAFETY	Accident Reports. (See the specifications for information required in the Accident Reports.)	Submitted to the Engineer within (24) hours of the occurrence.
01390	HEALTH AND SAFETY	Air monitoring/sampling equipment calibration and maintenance records. (See the specifications for information required in the Air monitoring/sampling equipment calibration and maintenance records.)	Submitted to the Engineer on request and/or at the completion of work.
01390	HEALTH AND SAFETY	Close-Out Safety Report. (See the specifications for information required in the Close-Out Safety Report.)	Submitted to the Engineer at the completion of work.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
01392	ENVIRONMENTAL SAMPLING AND QUALITY ASSURANCE	As part of the requirement of the Environmental Quality Assurance Project Plan, the following data will be submitted by the Contractor for the following phases of remedial action. (1) Construction, and (2) Soil Vapor Extraction System Operation. The data shall include: A. Laboratory Data. B. Validated Data. C. Field Measurement Logbook. D. Sample Collection Data Logbook. E. Chain-of-Custodies. F. Quality Assurance Non-Conformances - Field. G. Quality Assurance Non-Conformances - Laboratory. H. Laboratory qualifications and QA/QC procedures.	Submit to the Engineer 30 days after receipt of analytical data.
01395	ENVIRONMENTAL CONTROL	Environmental Conditions Survey Report. (See the specifications for information required in the Environmental Conditions Survey Report.)	A minimum of (5) working days in advance of commencing the related work.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
01396	AIR MONITORING	As part of the requirements of the Air Monitoring Plan, the Contractor will be submit; A. Air Monitoring Reports. (1) Phase I - Background (2) Phase II - Remedial Action Construction (3) Phase III - Remedial Action Operations. B. Analytical Results (Verbal and Written). C. Sample Information Sheets. D. Meteorological Data. E. Calibration Records.	Submit written analytical results to the Engineer 30 days after receipt of chemical analysis. Submit daily PID measurements log weekly to the Site Safety Officer and Engineer.
01397	**SITE MANAGEMENT**	**Contractor Site Management Plan (SMP). (See the specifications for information required in the SMP.)** **MAJOR SUBMITTAL**	**Submit to the Engineer 14 days after EPA conceptual level concurrence with the SVE system methodology.**
01400	**CONTRACTOR QUALITY CONTROL PLAN**	**Contractor Quality Control Plan.** **MAJOR SUBMITTAL**	**Submit to the Engineer 14 days after EPA conceptual level concurrence with the SVE system methodology.**

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
01400	CONTRACTOR QUALITY CONTROL PLAN	Site Superintendent's Reports: a. Daily Report. b. Submittal Register. c. Daily QC Report. d. Report of Field Changes e. Progress Report. f. Photographic Report Data Sheet. g. Corrective Actions Report.	Contractor shall provide a procedure for scheduling submittals as part of his Contractor Quality Control Plan.
01400	CONTRACTOR QUALITY CONTROL PLAN	Contractor Quality Control Manager's Reports: a. Non-Compliance Notification. b. Material Certifications with CQC Transmittal Form	Contractor shall provide a procedure for scheduling submittals as part of his Contractor Quality Control Plan.
01525	PROJECT IDENTIFICATION AND SIGNS	Shop Drawings for the Project Identification and Information Signs showing sign content, layout, lettering and colors.	A minimum of (5) working days in advance of commencing the related work.
01700	PROJECT RECORD DOCUMENTS/PROJECT CLOSEOUT	All Project Record Documents. (See the specifications for information required as part of the Project Record Documents.)	Submitted to the Engineer within (30) days of the completion of work.
02175	CULVERTS	Manufacturer's technical product data and installation instructions for culvert materials and products.	A minimum of (5) working days in advance of commencing the related work.
02185	SUMP GROUTING	Manufacturer's product data and certifications for all materials and specialty equipment used.	A minimum of (5) working days in advance of commencing the related work.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
02185	SUMP GROUTING	Sump Investigation Report.	A minimum of (5) working days in advance of commencing the related work.
02186	CONCRETE PAD DEMOLITION	Concrete Pad Demolition Plan.	Submitted with the Contractor's bid.
02190	WELL ABANDONMENT	Manufacturer's product data and certifications for all materials and specialty equipment used.	A minimum of (5) working days in advance of commencing the related work.
02200	EARTHWORK	Excavation Plan for the Southern Concrete Pad Area.	Submitted with the Contractor's bid.
02200	EARTHWORK	Fill and Backfill Materials source list and test results.	At least (1) week before the Contractor commences delivery of the materials to the site.
02200	EARTHWORK	Fill and Backfill Material samples.	At least (1) week before the Contractor commences delivery of the materials to the site.
02200	EARTHWORK	Topsoil Chemical Analysis.	At least (1) week before the Contractor commences delivery of the materials to the site.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
02205	SHEET PILE CUTOFF WALL	Pre-Construction Test Drilling Plan. (See the specifications for information required as part of the Pre-Construction Test Drilling Plan.)	Submitted with the Contractor's bid.
02205	SHEET PILE CUTOFF WALL	Sheet Pile Cutoff Plan. (See the specifications for information required as part of the Sheet Pile Cutoff Plan.)	Submitted with the Contractor's bid.
02210	CONSTRUCTION DEWATERING	Construction Dewatering Plan. (See the specifications for information required as part of the Construction Dewatering Plan.)	Submitted with the Contractor's bid.
02280	GEOTEXTILES	Geotextile Manufacturer's Product Data. (See the specifications for information required as part of the Geotextile Manufacturer's Product Data.)	A minimum of (5) working days in advance of commencing the related work.
02280	GEOTEXTILES	Geotextile Manufacturer's Product Certificates of Conformance.	A minimum of (5) working days in advance of commencing the related work.
02280	GEOTEXTILES	Geotextile Manufacturer's Product Samples.	A minimum of (5) working days in advance of commencing the related work.
02281	HIGH DENSITY POLYETHYLENE LINER	HDPE Geomembrane Manufacturer's Product Data. (See the specifications for information required as part of the HDPE Geomembrane Manufacturer's Product Data.)	A minimum of (5) working days in advance of commencing the related work.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
02281	HIGH DENSITY POLYETHYLENE LINER	HDPE Geomembrane Manufacturer's Product Certificates of Conformance.	A minimum of (5) working days in advance of commencing the related work.
02281	HIGH DENSITY POLYETHYLENE LINER	HDPE Geomembrane Manufacturer's Product Samples.	A minimum of (5) working days in advance of commencing the related work.
02281	HIGH DENSITY POLYETHYLENE LINER	HDPE Geomembrane field panel layout plan and pipe penetration details.	A minimum of (5) working days in advance of commencing the related work.
02282	GEOCOMPOSITE DRAINAGE NET	Geocomposite Drainage Netting Manufacturer's Product Data. (See the specifications for information required as part of the Geocomposite Drainage Netting Manufacturer's Product Data.)	A minimum of (5) working days in advance of commencing the related work.
02282	GEOCOMPOSITE DRAINAGE NET	Geocomposite Drainage Netting Manufacturer's Product Certificates of Conformance.	A minimum of (5) working days in advance of commencing the related work.
02282	GEOCOMPOSITE DRAINAGE NET	Geocomposite Drainage Netting Manufacturer's Product Samples.	A minimum of (5) working days in advance of commencing the related work.
02283	TEMPORARY COVERS	Temporary Cover Material Manufacturer's Product Data. (See the specifications for information required as part of the Temporary Cover Material Manufacturer's Product Data.)	A minimum of (5) working days in advance of commencing the related work.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
02283	TEMPORARY COVERS	Temporary Cover Material Manufacturer's Product Certificates of Conformance.	A minimum of (5) working days in advance of commencing the related work.
02283	TEMPORARY COVERS	Temporary Cover Material Manufacturer's Product Samples.	A minimum of (5) working days in advance of commencing the related work.
02550	MONITORING WELLS	Well installation Material Manufacturer's Product Data. (See the specifications for information required as part of the Well Installation Material Manufacturer's Product Data.)	A minimum of (5) working days in advance of commencing the related work.
02550	MONITORING WELLS	Well installation method report and list of drilling equipment.	A minimum of (5) working days in advance of commencing the related work.
02700	EROSION CONTROL	Silt Fence Fabric Manufacturer's Product Data. (See the specifications for information required as part of the Silt Fence Fabric Manufacturer's Product Data.)	A minimum of (5) working days in advance of commencing the related work.
02700	EROSION CONTROL	Silt Fence Fabric Manufacturer's Product Certificates of Conformance.	A minimum of (5) working days in advance of commencing the related work.
02700	EROSION CONTROL	Silt Fence Fabric Manufacturer's Product Samples.	A minimum of (5) working days in advance of commencing the related work.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
02750	EROSION CONTROL REVETMENT	Erosion Control Revetment Manufacturer's Product Data. (See the specifications for information required as part of the Erosion Control Revetment Manufacturer's Product Data.)	A minimum of (5) working days in advance of commencing the related work.
02750	EROSION CONTROL REVETMENT	Erosion Control Revetment Manufacturer's Product Certificates of Conformance.	A minimum of (5) working days in advance of commencing the related work.
02750	EROSION CONTROL REVETMENT	Erosion Control Revetment Manufacturer's Product Samples.	A minimum of (5) working days in advance of commencing the related work.
02900	OFFSITE TRANSPORTATION AND DISPOSAL	Copies of certificates of required insurance, permits and licenses for Offsite Transportation and Disposal providers. (See the specifications for complete description of information required.)	Submitted with the Contractor's bid.
02900	OFFSITE TRANSPORTATION AND DISPOSAL	Copies of weigh-in/weigh-out tickets, with driver name, truck identification, date and time of day.	Withing (5) days of waste delivery.
02900	OFFSITE TRANSPORTATION AND DISPOSAL	Copies of manifests.	Withing (5) days of waste delivery.
02900	OFFSITE TRANSPORTATION AND DISPOSAL	Waste analyses results and waste profile sheets.	Withing (5) days of waste delivery.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
03200	CONCRETE REINFORCEMENT	Concrete reinforcement materials manufacturer's certification of products.	A minimum of (5) working days in advance of commencing the related work.
03300	CAST-IN-PLACE CONCRETE	Concrete mixing plant material and mix certification	A minimum of (5) working days in advance of commencing the related work.
03300	CAST-IN-PLACE CONCRETE	Concrete cylinder test results.	Within (5) days of completion of testing.
13100	**SOIL VAPOR EXTRACTION SYSTEM**	**SVE System Final Design. (See the specifications for information required as part of the SVE System Final Design.)** **MAJOR SUBMITTAL**	**30 calendar days after U.S. EPA conceptual level concurrence with the SVE system methodology.**
13100	**SOIL VAPOR EXTRACTION SYSTEM**	**SVE System Shop Drawings. (See the specifications for information required as part of the SVE System Shop Drawings.)** **MAJOR SUBMITTAL**	**30 calendar days after U.S. EPA conceptual level concurrence with the SVE system methodology.**
13100	**SOIL VAPOR EXTRACTION SYSTEM**	**SVE System, Materials and Equipment Manufacturer's Descriptive literature, specifications and product Certifications.** **MAJOR SUBMITTAL**	**30 calendar days after U.S. EPA conceptual level concurrence with the SVE system methodology.**

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
13110	WASTEWATER TREATMENT SYSTEM	Wastewater Treatment System Shop Drawings. (See the specifications for information required as part of the Shop Drawings.)	(30) calendar days after award of Contract.
13110	WASTEWATER TREATMENT SYSTEM	Wastewater Treatment System, Materials and Equipment Manufacturer's Descriptive literature, specifications and product Certifications.	(30) calendar days after award of Contract.
13110	WASTEWATER TREATMENT SYSTEM	Wastewater Treatment System Startup Test Report.	(15) calendar days after completion of startup.
13120	STRUCTURES	Complete Plans, Sections and Details of the Soil Vapor Extraction System Building, if proposed.	(2) weeks prior to the start of building construction.
13120	STRUCTURES	Building Materials and Equipment Manufacturer's Descriptive literature, specifications and product Certifications. (See the specifications for a minimum list of materials and equipment requiring submittals.)	(2) weeks prior to the start of building construction for the wastewater treatment system and transfer buildings.
13200	SOIL VAPOR EXTRACTION SYSTEM OPERATIONS STARTUP	SVE System Pre Startup Inspection, Testing and Calibration Checklist. (NOT COMPLETED for review.)	(2) weeks prior to system startup.
13200	SOIL VAPOR EXTRACTION SYSTEM OPERATIONS STARTUP	SVE System Pre Startup Inspection, Testing and Calibration Checklist. (COMPLETED for review.)	Prior to system startup.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
13200	SOIL VAPOR EXTRACTION SYSTEM OPERATIONS STARTUP	SVE System Operations Startup Data Collection Plan. (See specifications for information required as part of the SVE System Operations Startup Data Collection Plan.)	(2) weeks prior to system startup.
13200	SOIL VAPOR EXTRACTION SYSTEM OPERATIONS STARTUP	SVE System Operations Weekly Startup Reports. (See specifications for information required as part of the SVE System Operations Startup Report.)	(3) days after completion of each week of startup operation.
13200	SOIL VAPOR EXTRACTION SYSTEM OPERATIONS STARTUP	SVE System Operations Completed ~~Startup~~ Shakedown Report. (See specifications for information required as part of the SVE System Operations Startup Report.)	(4) weeks after completion of system startup.
13210	**SITE OPERATIONS AND MAINTENANCE**	**Site Operations and Maintenance Manual. (See specifications for a sample outline to be used as a guide to creation of a manual.)** **MAJOR SUBMITTAL**	**(30) days after completion of the SVE System Operations Startup Report.**
13050	WASTEWATER STORAGE AND TRANSFER SYSTEM	Wastewater Storage and Transfer System Shop Drawings. (See the specifications for information required as part of the SVE System Shop Drawings.)	30 calendar days after award of Contract.
13050	WASTEWATER STORAGE AND TRANSFER SYSTEM	Wastewater Storage and Transfer System, Materials and Equipment Manufacturer's Descriptive literature, specifications and product Certifications.	30 calendar days after award of Contract.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
13050	WASTEWATER STORAGE AND TRANSFER SYSTEM	Wastewater Storage and Transfer System Pre Startup Inspection, Testing and Calibration Checklist.	(10) calendar days prior to system startup.
13050	WASTEWATER STORAGE AND TRANSFER SYSTEM	Wastewater Storage and Transfer System Startup Report. (See specifications for information required as part of the Startup Report.)	(10) calendar days after system startup.
16010	GENERAL ELECTRICAL WORK	Electrical Power Supply and Control System Shop Drawings. (See the specifications for information required as part of the SVE System Shop Drawings.)	30 calendar days after award of Contract.
16010	GENERAL ELECTRICAL WORK	Electrical Power Supply and Control System, Materials and Equipment Manufacturer's Descriptive literature, specifications and product Certifications.	30 calendar days after notice to proceed with installation.
16010	GENERAL ELECTRICAL WORK	Electrical Power Supply and Control System Pre Startup Inspection, Testing and Calibration Checklist.	(10) calendar days prior to system startup.
16010	GENERAL ELECTRICAL WORK	Electrical Power Supply and Control System Operations Manual. (See specifications for information required as part of the Startup Report.)	(10) calendar days after system startup.
16500	LIGHTING FIXTURES	Lighting System Shop Drawings. (See the specifications for information required as part of the SVE System Shop Drawings.)	30 calendar days after award of Contract.

SPEC. SECTION	SPECIFICATION TITLE	SUBMITTAL DESCRIPTION	SUBMITTAL DATE
16500	LIGHTING FIXTURES	Lighting System, Materials and Equipment Manufacturer's Descriptive literature, specifications and product Certifications.	30 calendar days after notice to proceed with installation.
16500	LIGHTING FIXTURES	Lighting System Pre Startup Inspection, Testing and Calibration Checklist.	(10) calendar days prior to system startup.

1.02 SUBMISSION REQUIREMENTS

A. Coordination of Submittal Items:

Prepare and transmit each submittal a minimum of 5 working days in advance of performing the related work or other applicable activities, or within the time specified in the Contractor Submittals Summary - Table 01300-1, or the individual work sections of the Specifications, so that the installation will not be delayed by processing times including revision and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery, and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the work.

B. Number of Submittals Required:

1. Submit four copies to the Engineer unless stated elsewhere in the Contract Documents or as directed by the Engineer.

C. Transmittal Form:

1. All submittals, regardless of origin, shall have a transmittal form with the following identification data, as applicable, contained thereon:

    a. Date of submission and dates of any previous submissions.

    b. Project name and contract number.

    c. Contractor's name and address.

    d. Supplier's name and address.

    e. Manufacturer's name and address.

    f. Submittal or resubmittal number.

    g. Title or identification of submittal.

    h. References to applicable Specification paragraphs and Drawings.

    i. Contractor's Certification Statement.

    j. Deviations from Contract Documents.

D. Review the Submittals:

1. After review by the Engineer, the Trustees and, if necessary, U.S. EPA and IDEM, submittals, including shop drawings, product data, and samples will be returned to the Contractor stamped with one of the following classifications:

   a. RECORD COPY: Items not reviewed or items for which submittals are not required.

   b. NO EXCEPTIONS NOTED: No correction, no marks. All items may be fabricated. Resubmission of shop drawing, product data, or sample is not required.

   c. EXCEPTIONS NOTED: Minor corrections. All items included in submittal may be fabricated as marked up by the Engineer without further resubmission.

   d. REVISE AND RESUBMIT: Major corrections. No items shall be fabricated. Resubmit drawings in accordance with original submission with corrections noted.

   e. REJECTED: Items not in conformance with the Contract Documents. No items shall be fabricated. Correct and resubmit drawings conforming with the Contract Documents.

2. No portion of the work requiring a shop drawing, product data, or sample shall be commenced nor shall any material be fabricated or installed prior to review of the shop drawing, product data, or sample by the Engineer and the submittal returned to the Contractor marked "NO EXCEPTIONS NOTED" or "EXCEPTIONS NOTED". Fabrication performed, materials purchased, onsite construction accomplished which does not conform to these returned submittals shall be at the Contractor's risk and expense. The Engineer shall not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

3. Any need for resubmittal of required submissions will not extend Contract Time.

E. Resubmission Requirements:

1. Make any corrections or changes in the submittals required by the Engineer and resubmit until approved.

2. Indicate any changes that have been made in addition to those requested by the Engineer.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01310 - PROGRESS SCHEDULES AND REPORTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes procedures for preparation and submittal of the Contractor's Progress Schedule, periodic updating of the Contractor's Progress Schedule, and Monthly Progress Reports. The Contractor's Progress Schedule shall be prepared using Primavera or equivalent software as approved by the Engineer.

1.02 SUBMITTALS

A. The Contractor's Progress Schedule shall be submitted to the Engineer for review at least 10 working days prior to the Pre-Work Conference. The Contractor's Progress Schedule will be discussed at the Pre-Work Conference.

B. The Contractor's Progress Schedule shall be updated periodically and shall be submitted with each regular progress meeting.

1.03 FORMAT

A. Progress schedule shall be presented in the form of a bar chart.

B. Identify the project as ECC Site at the top of progress schedule.

C. Each major task or segment of work shall be represented by one horizontal bar.

D. Milestone dates for the completion of each phase of work shall be indicated.

E. Sequence of Listings: The chronological order of the start of each major operation or segment of work will determine the vertical location of its bar on the chart.

F. Horizontal Time Scale: Bold vertical lines for weeks, light vertical lines for days, with date given for beginning of each week.

G. Scale and Spacing: To allow space for notations and future revisions.

H. Minimum Sheet Size: 11 inches by 17 inches.

1.04 CONTENT

A. The complete sequence of work by activity shall be shown, with dates for beginning and completion of each major segment.

B. The bar representing each major operation or segment of the work shall be identified by Specification section number coinciding with items of these Specifications.

C. A subschedule bar chart shall be prepared to define critical portions of major tasks.

D. Estimated accumulated percentage of completion of each item, and estimated total percentage of work completed as of the last day of each month shall be noted at appropriate points on the chart.

1.05 REVISIONS TO SCHEDULES

A. Progress of each activity to the date of revision submittal, shall be indicated and an estimate given for completion date.

B. Changes that occurred since previous schedule submittal shall be shown:

1. Changes in scope or quantities.

2. Activities modified.

3. Revised estimates of progress and completion.

4. Other changes.

C. A narrative report shall be prepared at the Engineer's request to define:

1. New problem areas, expected delays, and their impact on schedule.

2. Corrective action taken or proposed, and their effects.

3. The effects of changes made or proposed on the functioning of subcontractors.

D. Schedule revisions and date revisions shall be consecutively numbered and dated.

1.06 MONTHLY PROGRESS REPORTS

A. Contractor Monthly Progress Report:

1. The Contractor will prepare a Monthly Progress Report for submittal to the Engineer which shall include:

a. Validated sampling and/or test data generated since the last report.

b. Description of all portions of the work completed and other appropriate supporting documentation such as:

(1) Invoices.

(2) Photographs.

(3) Contract documents.

c. Describe all actions, data, and plans which are scheduled for the next month including information relating to the progress of construction.

d. Information regarding percentage of completion and unresolved delays.

1.07 DISTRIBUTION AND REVIEW

A. Progress Schedule:

1. Five copies of updated schedules will be distributed to the Engineer.

2. All distributions will be transmitted with a cover letter.

3. Latest schedule is to be posted at the job site.

4. The Engineer will review and return each submittal of progress schedules within 1 week after receipt.

5. Contractor will resubmit within 3 days after return of review copy, if required.

B. Monthly Progress Reports:

1. Contractor Monthly Progress Report:

a. Five copies of the Monthly Progress Report will be distributed to the Engineer by the 4th day of each month.

b. The Engineer will review and return each submittal of the progress report by the 8th day of each month.

c. The Contractor will revise the progress report and submit five copies to the Engineer by the 10th day of each month.

d. The Engineer will submit the progress report to the U.S. EPA and IDEM by the 14th day of each month.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01380 - CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.01 SCOPE

A. This section covers project photographs to be submitted by the Contractor in order to document construction activities.

1.02 GENERAL REQUIREMENTS

A. The documentation shall provide a complete record of events including progression of work, potential and actual problems and solutions, and actual conditions which may vary from contract conditions.

B. Photographs shall be taken throughout the project period as approved by the Engineer. Each photograph shall be processed color prints. All photographs shall be taken using Kodak Royal Gold 100 ASA color print film only. The camera will be a professional quality Nikon, Canon or Minolta single lens reflex camera. Except where wide-angle view is necessary, all photographs will be taken with a fixed 50 mm lens. No zoom lens are permitted. All lens will be only original manufacturer Nikon, Canon or Minolta lens. No substitute lens shall be permitted. Photographs shall be date and time stamped and of clear professional quality.

1.03 SUBMITTALS

A. Photographs:

1. The Contractor shall provide 4-inch x 6-inch glossy color photographs of the following work tasks and areas. A minimum of two individual views is required for each item as shown in parentheses:

a. Before the work begins:

(1) All areas designated temporary and permanent easements (two each area).

(2) Proposed locations of temporary site facilities (two each Site).

(3) Borrow areas (two).

(4) Southern concrete pad (two).

(5) Access gates (two each).

(6) Existing roads to access the Site (two each).

(7) Existing diversion channels (Parcel 45 and support zone).

b. At the completion of site preparation, two views shall be obtained for each added facility.

c. During the project work all major work activities at least once per month and at such intervals as necessary to provide complete documentation. The following shall be considered major activities as a guide in selecting photograph locations. Two views of each activity shall be provided:

(1) Construction of temporary facilities, utilities, and access roadways to the Site.

(2) Construction of wastewater storage tanks and transfer system.

(3) Southern concrete pad excavation and backfill work.

(4) Crushed concrete and soil fill.

(5) Stage 1 cover placement.

(6) Monitoring well installation.

(7) Wastewater treatment system installation.

(8) SVE system construction.

2. Two 4-inch x 6-inch color prints and four color slides of each photograph shall be provided.

3. The photography effort shall be spaced out, as appropriate, over each activity period to provide views representative of the entire project work.

4. The prints and slides with appropriate identification and other information as directed shall be delivered to the Engineer as soon as they have been processed. Identification shall include the date of the photograph and a brief description of photograph coverage. Each photograph shall be numbered in sequence. Each photograph shall be cross referenced with a map showing the photograph number and directional arrow of the shot.

5. At least once a month during construction and up to start-up of the SVE system, the Contractor shall furnish aerial views of the Site from low elevation. One view shall be shot directly from overhead showing the entire Site on one photograph, with additional views showing areas of active work in greater detail. The Contractor shall furnish four 11-inch x 14-inch color photographs of each view.

B. Negatives:

1. Negatives are to be delivered to the Engineer with Record Documents. Negatives shall be catalogued and indexed in chronological sequence with a typed table of contents.

2. All photographs and negatives are the property of the ECC Trust and shall not be released by the Contractor to the public, news media, or anyone else without prior written permission of the Engineer after consultation with the ECC Trust.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01385 - APPROVALS AND PERMITS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes the requirements for the waste haulers and the disposal facilities.

1.02 LETTERS OF COMMITMENT

A. Letters of Commitment shall be obtained by the Contractor from waste haulers and from the disposal facilities who will handle and dispose of wastes removed from the Site. In the event that a disposal facility is prohibited from issuing a Letter of Commitment without a sample of the waste, a conditional type of letter will be acceptable. Such a conditional letter shall specifically state what types and quantities of waste the facility will accept.

B. The Letter of Commitment shall be submitted with the Contractor's bid.

1.03 SUBMITTALS

A. The following information shall be submitted with the Letters of Commitment.

1. Waste Haulers.

    a. Name and U.S. EPA identification number.

    b. Address.

    c. Name and telephone number of responsible contact for the hauler.

    d. List of types and sizes of transport vehicles and equipment to be used.

    e. A description of proposed transportation methods and procedures for hauling waste material.

    f. Any and all necessary permit authority for each type of waste transported.

    g. Emergency Response Plan for accidental releases.

2. Disposal Facilities:

a. Hazardous Disposal Facilities:

(1) The Contractor shall submit the following information on RCRA approved offsite disposal facilities where he is planning to take contaminated materials from the Site:

(a) Facility name and U.S. EPA identification number.

(b) Facility location.

(c) Name and telephone number of responsible contact for the facility.

(d) Signed Letter of Agreement to accept wastes from this Site.

b. Non-Hazardous Disposal Facilities:

(1) The Contractor shall submit the following information on non-hazardous disposal facilities where he is planning to take non-hazardous materials from the Site:

(a) Facility name.

(b) Facility location.

(c) Name and telephone number of responsible contact for the facility.

(d) IDEM special waste certification approval.

B. Approvals and Permits.

1. Prior to award of the Contract, the following information shall be required by the U.S. EPA and the ECC Trust:

a. A listing of all permits, licenses, letters of approval, and other authorizations to operate held by the proposed facility as they pertain to receipt and management of wastes derived from this contract.

b. A listing of all permits, licenses, letters of approval, and other authorizations to operate applied for by the proposed facility but not yet granted or issued. Provide dates of application(s) submitted. Planned submittals shall also be noted.

c. Specify and describe the unit(s) at the facility proposed to be used to manage site-derived waste and provide dates of construction and beginning of use. Drawings may be provided. Identify the capacity available in the units and the capacity reserved for the subject waste.

d. Provide the date of the proposed facility's last compliance inspection performed by any governmental unit, including RCRA, if applicable.

e. List all active completed compliance orders (or agreements), enforcement notices, or notices of violation issued to the proposed facility. State the source and nature of the cause of contamination, if known. If groundwater contamination is noted, provide details of facility groundwater monitoring program.

f. State whether the proposed facility will certify compliance with all applicable RCRA groundwater monitoring and financial responsibility requirements on or before the contract Notice to Proceed date. (Applies only to RCRA-regulated disposal facilities.)

C. Application for Special Waste:

1. The Contractor shall obtain a sample Special Waste Certification Application for special waste approval by IDEM.

2. The Contractor shall submit a completed application to IDEM for approval to dispose of the structures and their contents, miscellaneous debris areas, SVE pilot study area, other site debris, existing fencing, and site clearing items as special waste in an approved IDEM permitted municipal solid waste landfill.

3. The Engineer will direct the Contractor as to which materials need sampled in order to receive the Special Waste Classification from IDEM.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01390 - HEALTH AND SAFETY

PART 1 - GENERAL

1.01 SUMMARY

A. This section describes the minimum technical requirements and guidelines for health and safety during remedial activities.

B. A General Health and Safety Plan (HSP) has been prepared and is a part of the Contract Documents. This HSP provides the minimum requirements for project health and safety and shall be used, in conjunction with this Section, by the Contractor in preparation of the CHSP. This CHSP shall establish, in detail, the protocols necessary for the recognition, evaluation, and control of all hazards associated with each task performed by the Contractor and its subcontractors, and shall comply with all applicable laws and regulations including 29 CFR 1910.120 and 29 CFR 1926.

Nothing in the HSP or in the CHSP shall absolve the Contractor from complying with the provisions of the Contract Documents related to health and safety, even if those requirements are in addition to or more stringent than the provisions of either of those plans.

1.02 RESPONSIBILITIES

A. The CHSP shall be prepared by the Contractor and submitted in accordance with the requirements of Section 01300 - SUBMITTALS. The approved CHSP, complete with all comments addressed, shall become part of the Contract Documents.

B. The Contractor shall be responsible for the implementation and enforcement of all health and safety practices as described/outlined in the CHSP and applicable laws and regulations. This would include, but not be limited to, all precautions for safety and would provide the necessary protection to prevent damage, injury, or loss to work equipment or materials, property including adjacent property, Contractor, subcontractor, and other authorized personnel.

1.03 PERSONNEL

A. Health and Safety Officer:

1. The Contractor shall utilize the services of an industrial hygienist certified by the American Board of Industrial Hygiene in Comprehensive Practice to serve as the Project Health and Safety Officer (HSO). The HSO will be responsible for developing and implementing the CHSP, conducting initial onsite training, and providing onsite consultation to ensure the CHSP is fully implemented. The HSO shall also be part of the Quality Control (QC) staff. The minimum qualifications of the HSO shall include:

   a. Minimum of 3 years experience in developing and implementing health and safety programs at hazardous waste sites.

   b. Demonstrated experience in supervising professional and technician level personnel.

   c. Demonstrated experience in developing worker exposure assessment programs and ambient air monitoring programs including the siting of monitoring and meteorological stations.

2. The name, qualifications, and work experience of the HSO shall be submitted along with the Contractor's Bid. Any substitution of this position must be requested by the Contractor in writing and formally approved by the Engineer.

B. Site Safety Officer:

1. The Health and Safety Site Officer (SSO) shall assist and represent the HSO in the implementation and enforcement of the CHSP. The SSO shall be assigned to the project on a full-time basis and shall be a Contractor's employee who reports to the HSO in matters pertaining to site safety and health. The SSO shall be responsible for the day-to-day administration of the overall program and implementation of the CHSP. The minimum qualifications of the SSO shall include:

   a. A minimum of 2 years working experience at hazardous waste sites with demonstrated experience in working with Level B personal protective equipment.

   b. Demonstrated experience in construction safety techniques and procedures.

c. A working knowledge of Federal and state health and safety regulations.

d. Specific training in personal and respiratory protective equipment program implementation and in the proper use of air monitoring instruments, air sampling methods, and procedures. Such training shall be conducted by the HSO or with the concurrence of the HSO.

e. Certification as having completed Cardiopulmonary Resuscitation/Basic Life Support (CPR/BLS) (American Heart Association and/or American Red Cross).

2. The name, qualifications (education summary and documentation), and work experience of the SSO shall be submitted along with the CHSP and approved by the Engineer prior to commencement of the Contractor's work at the Site.

C. Industrial Hygiene Technician:

1. The Contractor may use a Health and Safety Technician(s) (HST) to assist the SSO. An HST shall have appropriate training equivalent to the SSO in the specific area(s) in which they have responsibility. The HST shall not serve as a replacement for the SSO, but only function as an assistant. All HSTs must be under the supervision of the SSO.

2. The name(s), qualifications (education summary and documentation), work experience, and specific job function(s) shall be submitted along with the CHSP and approved by the Engineer prior to commencement of work by the HST(s) onsite.

D. Examining Physician:

1. The Contractor shall utilize the services of a licensed physician with experience in the practice of occupational medicine. The examining physician shall be responsible for developing a medical monitoring program in compliance with Title 29 Code of Federal Regulations (CFR), Part 1910.120(f).

1.04 APPLICABLE REQUIREMENTS, GUIDELINES, AND STANDARDS

A. The Contractor shall be responsible for the development and implementation of a CHSP specific to the scope of work consistent with, but not limited to, the requirements outlined below and the HSP. In the case that these requirements are conflicting, the one which offers the greatest degree of protection shall be followed.

1. Occupational Safety and Health Administration (OSHA) General Industry Standards found at 29 CFR 1910.

2. OSHA Construction Industry Standards found at 29 CFR 1926.

3. United States Environmental Protection Agency (U.S. EPA), Standard Operating Safety Guidelines, 1984.

4. U.S. Department of Health and Human Services (USDHHS), National Institute of Occupational Safety and Health (NIOSH), "Manual of Analytical Methods," 4th Edition.

5. U.S. EPA, Office of Occupational Health and Safety, "Guidelines for the Selection of Chemical Protective Clothing," 3rd Edition, February 1987.

6. NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, USDHHS/PHS/CDC/ NIOSH.

7. NIOSH Pocket Guide to Chemical Hazards, USDHHS/PHS/CDC/NIOSH, latest edition.

1.05 SUBMITTALS

A. The HSO shall prepare and submit the CHSP, as specified herein, in accordance with Section 01300 - SUBMITTALS.

B. Daily Safety Logs shall be maintained by the SSO and submitted to the Engineer on a daily basis. The logs shall include items specified in the CHSP.

C. Training Logs shall be maintained by the SSO and submitted to the Engineer on request throughout the project and at completion of the work. The logs shall include items specified in the CHSP.

D. Air Monitoring Results Reports shall be maintained by the SSO and submitted to the Engineer on a daily basis. These reports shall include items specified in the CHSP.

E. Weekly Safety Reports shall be prepared by the SSO and submitted weekly to the Engineer. The reports shall include items specified the CHSP.

F. A Close-Out Safety Report shall be submitted by the HSO on completion of the work. This report shall include items specified in the CHSP.

G. The SSO shall submit accident reports to the Engineer within 24 hours of occurrence.

H. Air monitoring/sampling equipment calibration/maintenance records shall be maintained by the SSO in accordance with the CHSP. These records shall be submitted to the Engineer on request and/or at the completion of the project.

1.06 GENERAL REQUIREMENTS FOR CHSP PREPARATION AND IMPLEMENTATION

A. Use of the Site prior to approval of the CHSP will be restricted to mobilization within the support zone. No personnel may enter the exclusion zone until formal approval of the CHSP by the Engineer.

B. Should any unforeseen safety-related hazard become evident during the performance of the work, the SSO shall bring such hazard to the attention of the Engineer, both verbally and in writing, for resolution as soon as possible. In the interim, the Contractor shall take necessary action to re-establish and maintain safe working conditions to safeguard onsite personnel, visitors, the public, and the environment.

C. Should the Contractor seek modification of any portion or provision of the CHSP, such modification shall be requested by the HSO in writing to the Engineer, and if approved, be authorized in writing.

D. Disregard for the provisions of these Health and Safety Specifications shall be deemed just and sufficient cause for ordering the stoppage of all work beyond the support zone until the matter has been rectified to the satisfaction of the Engineer. Any personnel found to be disregarding any provision of the CHSP shall be subject to immediate removal from further site work.

1.07 PERIMETER AIR MONITORING/SAMPLING

A. The HSO shall implement and oversee a personal and perimeter air monitoring/sampling program in accordance with the Air Monitoring Plan and Section 01396 of the Specifications.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01392 - ENVIRONMENTAL SAMPLING AND QUALITY ASSURANCE

(Rev. 2, 3/7/97)

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall be responsible for adhering to and implementing all requirements of the Quality Assurance Project Plan (QAPP) attached to these Specifications, except those items as noted in Section 1.01 E. The QAPP also includes the Field Sampling Plan, which is Attachment A to the QAPP, and any addenda to the FSP.

It is noted that all environmental sampling and quality assurance requirements related to air monitoring are not contained in the QAPP. These requirements are described in the Air Monitoring Plan. See Specification Section 01396 - AIR MONITORING.

B. The Quality Assurance Project Plan ensures the quality of the remedial action sampling and analytical activities by employing quality assurance procedures in accordance with U.S. EPA protocols.

C. The objectives of the Quality Assurance Project Plan are as follows:

1. To assure environmental sampling and chemical analysis is carried out in accordance with established quality control procedures.

2. To assure that appropriate documentation and data reporting procedures are followed.

D. Environmental Sampling and Quality Assurance requirements will be applicable for the following phases of the remedial action.

1. Construction.

2. Wastewater treatment system start-up and operation, including discharge monitoring.

3. Soil Vapor Extraction System start-up and operation.

4. Soil cleanup verification (vapor sampling only).

E. **Environmental Sampling and Quality Assurance requirements contained in the QAPP which are to be performed by others, independent of the Contractor, include the following items:**

1. Soil cleanup verification (groundwater and onsite soil sampling).

2. Post-cleanup compliance monitoring for groundwater and surface water.

1.02 SUBMITTALS

A. Laboratory Data.

B. Validated Data.

C. Field Measurement Logbook.

D. Sample Collection Data Logbook.

E. Chain-of-Custodies.

F. Quality Assurance Non-Conformances - Field.

G. Quality Assurance Non-Conformances - Laboratory.

H. Laboratory qualifications and QA/QC procedures.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01395 - ENVIRONMENTAL CONTROL

PART 1 - GENERAL

1.01 SUMMARY

A. This section covers the work required for the protection of the environment throughout the course of the project, except for those measures set forth in other sections of these Specifications.

B. Environmental protection shall be defined as the retention of the environment in its natural state, to the greatest extent possible, during the project implementation, and the enhancement of the natural appearance in its final condition.

C. Items to be considered under this section are air, water, and land resources and shall include noise, solid waste management, and management of other pollutants.

D. The Contractor shall be responsible for complying with all applicable Federal, state, and local laws concerning the prevention, abatement, and control of all environmental pollution arising from the project activities.

1.02 SUBMITTAL

A. Environmental Conditions Survey Report.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.01 PROTECTION OF LAND RESOURCES AND WETLANDS

A. The Contractor shall confine his project activities to the work areas shown on the Drawings.

B. The Contractor shall take all measures necessary to prevent tracking of mud and dirt onto adjacent public roadways. These measures shall include a gravel construction entrance. Adjacent public roadways shall be cleaned as often as necessary to maintain a dust and mud free surface.

C. The Contractor shall make every effort to minimize the impact of construction in wetlands. No stockpiling of excavated or backfill material will be permitted in wetland designated areas.

3.02 PROTECTION OF WATER RESOURCES

A. The Contractor shall implement special measures to prevent chemicals, fuels, oils, greases, excavated materials, and decontamination fluids from entering public waters.

B. The Contractor shall, at all times, perform work in a manner that minimizes the interference with or the disturbance to fish and wildlife.

3.03 BURNING

A. Under no circumstances shall the burning of debris or waste materials be conducted at the Site.

3.04 TEMPORARY CONTROLS

A. Noise Control:

The Contractor shall conduct his operations so as not to violate any applicable ordinances, regulations, rules, and laws. All construction machinery and vehicles shall be equipped with practical sound-muffling devices and operated in a manner to cause the least noise, consistent with efficient performance of the work. If necessary vehicle speeds will be lowered to reduce noise and dust, however, this will be done with no impact to the cost or schedule of the project.

B. Dust Control:

The Contractor shall take reasonable measures to prevent unnecessary dust. Earth surfaces subject to dusting shall be kept moist with water. Dusty materials in piles or in transit shall be covered to prevent blowing.

C. Water Control:

The Contractor shall provide for the drainage of stormwater and such water as may be applied or discharged on the Site in performance of the work. Drainage facilities shall be adequate to prevent damage to the work, the Site, and adjacent property.

D. Erosion Control:

1. The Contractor shall prevent erosion of soil on the Site and adjacent property resulting from his construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operations that will disturb the natural protection.

2. Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation preserved to the greatest extent practicable.

3. Specific erosion control methods and products are listed in Section 02700 - EROSION CONTROL.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01396 - AIR MONITORING

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall be responsible for adhering to and implementing all requirements of the Air Monitoring Plan.

B. The Air Monitoring Plan includes procedures to detect and quantify offsite migration of air contaminants associated with remedial action construction and operations.

1.02 SUBMITTALS

A. Air Monitoring Reports:

1. Phase I - Background.

2. Phase II - Remedial Action Construction.

3. Phase III - Remedial Action Operations (air emissions from wastewater treatment system (air stripper) and the SVE system).

B. Analytical Results (Verbal and Written).

C. Sample Information Sheets.

D. Meteorological Data.

E. Calibration Records.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01397 - SITE MANAGEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This section provides general guidelines for management of onsite facilities and operations during the Remedial Action Construction and Operations. This section provides information on the support zone layout and operations, site security, and emergency procedures. This section will serve as the basis for the Contractor Site Management Plan (SMP) which will be submitted by the Contractor prior to commencement of onsite activities.

1.02 SUBMITTALS

A. Contractor Site Management Plan

1.03 CONTRACTOR SITE MANAGEMENT PLAN

A. Details and Acceptance of Plan:

1. The Contractor shall submit his proposed SMP to the Engineer for approval at least 3 working days prior to the Pre-Construction Conference. The U.S. EPA and IDEM will also review the SMP.

2. Pre-Construction Conference: The Contractor will meet with the Engineer, U.S. EPA, and IDEM to discuss the Contractor Site Management Plan, and to finalize the Contractor Site Management Plan in accordance with Section 01210 - PRE-CONSTRUCTION CONFERENCES. During the conference, details of the Plan shall be reviewed, such as: forms for recording site visitors, security activities, administration of the plan during progress of the Work, and communications with the Enviro-Chem Trustees Engineer concerning security problems and corrective actions.

3. The Contractor Site Management Plan shall include as a minimum, the following:

   a. A description of the Contractor's project organization and responsibilities, including at a minimum, the following personnel:

      1. Project Manager
      2. Site Superintendent
      3. Security Officer
      4. Site Safety Officer
      5. Quality Control Manager

   b. Support zone layout and operations plan during construction and operations, including temporary facilities, equipment laydown areas, water supply, parking, traffic control, and lighting.

   c. Site Security Plan during construction and operations, including access control, visitor documentation, and employee identification. Procedures shall be provided for addressing the following:

      1. Unauthorized person(s) found onsite.
      2. Unauthorized person(s) attempting to gain access.
      3. Vandalism.
      4. Broken fencing, gates, lighting or other damaged support zone facilities.
      5. Protection of equipment and materials.

4. Acceptance of Plan: Acceptance of the Contractor's plan by the Engineer, U.S. EPA and IDEM is required prior to the start of construction. Acceptance is conditional, and its continuation will depend on satisfactory performance by the Contractor during construction.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01400 - CONTRACTOR QUALITY CONTROL

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall prepare a Contractor Quality Control Plan (CQAP) which sets forth methods to establish and maintain an effective quality control system in compliance with requirements indicated herein and elsewhere in the Contract Documents. The CQAP shall adhere to the requirements of the Construction Quality Assurance Plan (CQAP) attached to these specifications.

1.02 DESCRIPTION

A. Contractor Quality Control (CQC) is a management system employed by the Contractor which assures that the construction complies with the requirements of the contract plans, specifications, and drawings. It includes a staff of personnel who represent the Contractor and who continually carry out a system of controls consisting of sampling, inspection, corrective measures and reporting, all toward the end of assuring the Contractor of construction in strict compliance with contract documents.

1.03 RELATED SECTIONS

A. Section 01210 - Pre-Construction Conference.

B. Section 01410 - Testing Laboratory Services.

1.04 SUBMITTALS

A. The following shall be submitted under the provisions of Section 01300 - SUBMITTALS:

1. Contractor Quality Control Plan

2. Site Superintendent's Reports:

a. Daily Report.

b. Submittal Register.

c. Daily QC Report.

d. Report of Field Changes

e. Progress Report.

f. Photographic Reporting Data Sheet.

g. Corrective Actions Report.

3. Contractor Quality Control Manager's Reports:

a. Non-Compliance Notification.

b. Material Certifications with CQC Transmittal Form.

1.05 CONTRACTOR QUALITY CONTROL PLAN

A. Details and Acceptance of Plan:

1. The Contractor shall submit his proposed CQC Plan and progress schedule to the Engineer for approval at least 3 working days prior to the Pre-Construction Conference. The U.S. EPA and IDEM will also review the CQC Plan. The plan shall identify personnel, and establish procedures, instructions, records, and forms to be used. If the Contractor fails to submit an acceptable Contractor Quality Control Plan, the ECC Trust may refuse to allow construction to start. In that event the ECC Trust may withhold funds from progress payments until such time as an acceptable final plan is submitted.

2. Pre-Construction Conference: The Contractor will meet with the Engineer, U.S. EPA, and IDEM to discuss the Contractor Quality Control Plan, and to finalize the Contractor Quality Control Plan in accordance with Section 01210 - PRE-CONSTRUCTION CONFERENCES. During the conference, details of the Quality Control Plan shall be reviewed, such as: forms for recording the Contractor Quality Control operations, control activities, testing, administration of the plan during progress of the Work, and interrelationship of the Contractor's inspections and control with the Engineer's inspections.

3. The Contractor Quality Control Plan shall include as a minimum, the following:

   a. A description of the Contractor's quality control organization, including a chart showing lines of authority, and acknowledgment that the Contractor's Quality Control staff shall conduct inspections for all aspects of the work specified, and shall report to the Project Manager or someone higher in the Contractor's organization.

   b. The name, qualifications, responsibilities, and authority of each person assigned to the Contractor's Quality Control organization.

   c. A copy of the letter to the Contractor's Quality Control Manager is signed by an authorized official of the firm, which describes the responsibility and delegates authority to the Contractor's Quality Control Manager.

   d. Procedures for scheduling and managing submittals, including those of subcontractors, fabricators, suppliers, and purchasing agents.

   e. Control procedures to be promulgated.

   f. Control testing procedures and visual checks for each specific test and activity, including field sampling in accordance with the attached Construction Quality Assurance Plan (CQAP) and the Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP).

   g. Reporting procedures including proposed reporting formats.

4. Acceptance of Plan: Acceptance of the Contractor's plan by the Engineer, U.S. EPA and IDEM is required prior to the start of construction. Acceptance is conditional, and its continuation will depend on satisfactory performance by the Contractor during construction. The Engineer reserves the right to require the Contractor to make changes in the Contractor Quality Control Plan and operations as necessary to obtain the quality specified.

5. Notification of Changes: After acceptance of the Contractor Quality Control Plan, the Contractor will notify the Engineer in writing of any proposed change. The proposed changes will be subject to acceptance by the ECC Trust, U.S. EPA, and IDEM.

B. Quality Control Organization:

1. Contractor Quality Control Manager: Contractor will name an individual, within his organization, who will be responsible for overall management of the Contractor's Quality Control at the ECC Site, and who will have authority to act in the Contractor Quality Control matters for the Contractor. The Contractor Quality Control Manager shall be experienced in hazardous waste remediation and shall possess adequate formal academic training in engineering and/or chemistry and have sufficient practical technical and managerial experience to successfully oversee and implement construction quality assurance activities. His sole responsibility is to verify compliance with the contract plans, specifications, and drawings. This person shall demonstrate the ability to perform the duties required to the satisfaction of the Engineer. The CQC Manager or his designated representative shall be physically at the project site whenever work is in progress.

2. Personnel: Contractor will hire and maintain under direction of the Contractor Quality Control Manager a staff to perform all Contractor Quality Control activities. Personnel of this staff shall be qualified by experience and technical training to perform their assigned duties. Actual strength of the staff during any specific work period may vary to cover work needs.

C. Manufacturer's Contributions:

1. Manufacturer's Instructions:

   a. The Contractor shall comply with manufacturer's instructions, including each step in sequence.

   b. Should instructions conflict with the contract documents, request clarification from the Engineer before proceeding.

2. Manufacturer's Certificates:

   a. When required in an individual specification section, submit manufacturer's certificate, certifying that products meet or exceed specified requirements, executed by responsible officer.

3. Manufacturer's Field Services:

   a. When required in an individual specification section, manufacturer or qualified representative shall observe and correct field conditions, conditions of installation, quality of workmanship, start-up of equipment, testing, adjusting, and balancing of equipment as applicable, and make a written report of observations and recommendations to the Engineer.

b. The qualified manufacturer's representative shall certify that the installation has been properly made.

4. Submittals:

a. Submittals shall be specified in Section 01300 - SUBMITTALS. The Contractor Quality Control organization shall be responsible for certifying that all submittals are in conformance with Contract requirements.

D. Implementation of Quality Control Plan:

1. General:

a. Comply with highest industry standards except when specified requirements indicate more rigid standards, or more precise workmanship is required.

b. Provide personnel to produce work of specified quality.

c. Secure, protect, and maintain products and work completed.

2.. Initial Inspection: This shall be performed as soon as a representative portion of the particular segment of work has been accomplished, and shall include examination of the quality of workmanship and materials, and a review of control testing for compliance with Contract requirements. The Engineer, U.S. EPA, and IDEM shall be notified at least 24 hours in advance of the initial inspection, and such inspection shall be made a matter of record in the Contractor Quality Control documentation.

3. Follow-up Inspections: These shall be performed regularly to assure continuing compliance with Contract requirements, including control testing, until substantial completion of the particular segment of work. Such inspection shall be made a matter of record in the Contractor Quality Control documentation. Final follow-up inspections shall be conducted and deficiencies corrected prior to final acceptance of segments of work.

4. Tests: A list of tests, and the frequency of their performance, which the Contractor understands he is to perform, and on which he is to submit reports shall include, but is not necessarily limited to, the following:

   a. Visual inspections and observations.

   b. Concrete tests.

   c. Geomembrane tests.

   d. Geotextile tests.

   e. Soil testing, including moisture content, grain size, Atterburg Limits, compaction, and permeability.

5. Contractor will submit the list (Paragraph 1.04.D.4 above) of tests, and the frequency of their performance, as a part of the Contractor's Quality Control Plan, to the Engineer. The list shall give the test name, Specification Paragraph containing the test requirements, and the personnel and/or laboratory responsible for each type of test. The Contractor will perform the following activities and record and provide the following data:

   a. Verify that testing procedures comply with contract requirements.

   b. Verify that facilities and testing equipment are available and comply with testing standards.

   c. Check test instrument calibration data against certified standards.

   d. Verify that recording forms, including all of the test documentation requirements, have been prepared.

6. Testing for Laboratory Capability:

   a. Capability Check: The Engineer will have the right to check laboratory equipment in proposed laboratories for compliance with the standards set forth in Section 01410 - TESTING LABORATORY SERVICES and to check laboratory testing procedures and techniques.

   b. Capability Rechecks: If the selected laboratory(ies) fails the capability check, the Contractor will be assessed actual costs to reimburse the ECC Trust for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs shall be deducted from amount due the Contractor under this Contract.

7. Completion Inspection:

a. Upon substantial completion of all work or any segment thereof as referenced in the contract documents, the Contractor Quality Control Manager shall conduct a completion inspection of the work and develop a "punch list" of items which do not conform to the approved Contract Documents. Such a list shall be included in the Contractor Quality Control documentation and shall include the estimated date by which the deficiencies will be corrected. The Contractor Quality Control Manager or his staff shall make a second completion inspection to ascertain that all deficiencies have been corrected, and so notify the Engineer. The completion inspection and any deficiency corrections required by this paragraph shall be accomplished within the time stated for completion of the entire work, or any particular segment thereof if the work is divided into segments with separate completion dates.

8. Documentation:

a. The Contractor will maintain current records of quality control operations, activities, and tests performed including the work of suppliers and subcontractors. These records shall be on an acceptable form and shall indicate a description of the trades working on the projects, the number of personnel working, weather conditions encountered, and delays encountered, and acknowledgment of deficiencies noted along with corrective actions taken on current or previous deficiencies. Additionally, these records shall include evidence that required activities or tests have been performed, including but not limited to the following:

(1) Type and number of control activities and tests performed.

(2) Results of control activities or tests, including nature of any defects, causes for rejection, and other information related to deficient features.

(3) Proposed remedies and accomplished corrections.

b. These records shall cover both conforming and defective features, and shall include a statement that supplies and materials incorporated in the work comply with contract requirements. Legible copies of these records shall be submitted to the Engineer.

9. Notification of Noncompliance:

a. The Engineer will notify the Contractor, the ECC Trust, IDEM, and the U.S. EPA project coordinator of any observed noncompliance with requirements of this section by the Contractor. If the Contractor fails or refuses to comply promptly, the Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time, or for extra compensation costs or damages by the Contractor.

1.05 REVIEW

A. The Engineer will review the Contractor Quality Control Plan and provide comments before the Pre-Work Conference.

B. The Contractor will make appropriate revisions and resubmit the Contractor Quality Control Plan within 7 days after the Pre-Work Conference.

PART 2 -PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01500 - TEMPORARY FACILITIES

Rev. 1, 2/7/97

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes Contractor requirements for providing, operating, and maintaining temporary support facilities.

1. Support Facilities:

a. Enviro-Chem Trustees Engineer office trailer.

b. Personnel decontamination trailer.

c. Sanitary facilities.

d. Other Contractor temporary facilities, such as office trailers, equipment and materials storage trailers and other facilities as needed for construction and operations shall be provided as needed by the Contractor.

B. At the completion of the construction work, the decontamination trailer and the Contractor's construction temporary facilities shall be removed from the Site. The Engineer office trailer, sanitary facilities, and the Contractor's operation support facilities shall be removed from the site at the completion of site operations and verification of soil cleanup.

1.02 OTHER REQUIREMENTS

A. The Contractor shall provide personnel protective equipment (PPE), as needed, for the Engineer. The types of PPE shall be as required by The General Health and Safety Plan. The Engineer shall provide his own full-face respirator.

B. The Contractor shall provide, as needed, separate facilities to accommodate male and female onsite personnel.

C. The Contractor shall maintain all facilities, equipment, and fixtures on a daily basis. Maintenance shall extend beyond the structures to all parking areas and all exterior portions of the support zone.

D. Field offices shall be equipped as specified and shall be available at the Site for the Engineer's use prior to the commencement of any field work under the Contract. The field office shall be located in the support zone as shown on the Drawings or as directed by the Engineer.

PART 2 - PRODUCTS

2.01 THE ENGINEER'S OFFICE TRAILER

A. The Contractor will provide and maintain a separate trailer for sole use of the Engineer, with a separate lockable entrance door. Three keys shall be provided.

B. The trailer shall have two offices with lockable doors, each office having a minimum of 100 square feet of floor area and a conference room with at least 200 square feet of floor area.

C. Offices shall be furnished as follows:

1. Desk with lockable drawers, chair, and table (60 inches x 30 inches).
2. Separate telephone line with telephone.
3. Four-drawer, fire resistant, lockable filing cabinet legal size.
4. Bookcase of three shelves 3 feet high x 12 inches deep x 3 feet long.
5. Personal computer, Pentium (133 MHz) processor, 16 mb RAM, 1 Gig hard drive, CD-Rom drive, and 28.8 bps modem.
6. Laserjet printer compatible with personal computer, for 8½ x 11-inch plots.

D. Conference room shall be furnished as follows:

1. Photocopying machine equipped with automatic feed, with adequate supply of copy paper. Copy paper shall be replenished by the Contractor during the course of the Contract.
2. Office table (96 inches x 30 inches) and 12 chairs.

3. Telephone line with speaker telephone (common telephone line with office).

4. Plan rack.

5. Waste basket.

6. Facsimile (fax) machine on separate dedicated telephone line.

E. The trailer shall be provided with air conditioning and heating units and ventilation to maintain a comfortable working environment.

F. Emergency backup electrical power generation shall be provided for the Engineer's office trailer

2.02 CONTRACTOR TEMPORARY FACILITIES

A. The Contractor will provide and maintain temporary facilities as needed for sole use by the Contractor and his Subcontractors, with separate lockable entrance doors.

B. The Contractor shall provide a minimum of four sets of personal protective health and safety field equipment for visitors and four sets of disposable clothing for the Engineer, ECC Trust, the U.S. EPA and IDEM on a daily basis in a readily accessible area.

2.03 PERSONNEL DECONTAMINATION TRAILER

A. The personnel decontamination facilities will be placed in the contamination reduction area and will consist of the following:

1. An enclosed dressing/undressing area equipped with storage racks, chairs, lockers, and separate facilities for male and female personnel including showers.

2. An area divided into stations for washing, removal, and disposal of personal protective gear. The stations will be set up into a logical sequence to reduce contamination being carried from each station.

B. The facility size will accommodate the largest number of employees expected onsite plus approximately four visitors.

C. Enclosed facilities will be provided with heating, ventilation, air conditioning, and proper lighting.

D. An emergency shower will be located on the outside of the facility. The shower shall be capable of operation year-round.

E. All water used in washing and decontamination will be disposed of in the wastewater storage tanker truck.

F. This trailer shall also include all requirements set forth in Section 01390 - HEALTH AND SAFETY, of these Specifications.

PART 3 - EXECUTION

3.01 PERFORMANCE

A. The Contractor shall locate all temporary facilities at locations approved by the Engineer and properly anchor them to withstand all weather conditions.

B. The Contractor shall provide dumpsters for general site trash collection with call services that are adequate for the activities conducted onsite. This material may include paper products, plastics, food, packing materials, and any other non-hazardous solid wastes. This waste does not include any remedial action generated waste as defined in Section 02080 - REMEDIAL ACTION GENERATED WASTES.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01502 - WASTEWATER STORAGE PAD

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall be responsible for operation and closure of the wastewater storage pad meeting the requirements of these Specifications and Drawings. The wastewater storage pad shall be used as a secondary containment area for wastewater storage tanker trucks which shall be used for loading of collected wastewaters and any other contaminated liquids generated or staged for disposal.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 INITIAL INSPECTION AND PREPARATION

A. The Contractor shall perform an initial inspection of the wastewater storage pad to assume that it is functional. The inspection shall include:

1. HDPE liner protective cover and aggregate continuity.

2. Drainage sump condition.

Repairs shall be performed as necessary and as directed by the Engineer.

B. Rainwater present on the wastewater storage pad and in the sump shall be pumped to an onsite diversion channel prior to wastewater storage pad inspection.

Excessive and/or continual flow into the sump during operations may indicate a liner leak and shall be reported to the Engineer.

C. The wastewater storage pad shall be cleared of vegetation, debris and sediment prior to it's use. Waste materials shall be managed as solid non-hazardous waste per Section 02080 - REMEDIAL ACTION GENERATED WASTES.

3.02 OPERATION

A. The Contractor shall be responsible for keeping the wastewater storage pad cleaned as required.

B. The Contractor shall also be responsible for pumping out any accumulation in the HDPE sump as required into the onsite wastewater storage tank designated as tank T1.

3.03 CLOSURE

A. At the completion of work activities associated with this Contract, the Contractor shall perform closure of the wastewater storage pad by removing all water from the sump. This water shall be pumped into the onsite wastewater storage tank designated as tank T1.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01510 - UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes requirements for providing, operating, and maintaining, all utilities associated with site preparation and material removal activities.

1. Utilities:

   a. Telephone.

   b. Electricity.

   c. Clean water.

   d. Sanitation.

B. Utilities shall be installed in such a way that they may be disconnected upon completion of this phase of the work, but easily reconnected for use in the future.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

A. Electricity and lighting shall be in accordance with Federal, state, and local regulations as well as local utility company requirements. All work shall be in accordance with the National Electric Code.

B. Sanitary facilities, and disposal of sanitary wastes, shall be in accordance with state and local regulations. The Contractor shall dispose of sanitary waste offsite at his own expense.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pipe material suitable for use with potable water may be standard weight galvanized steel, sized for unimpeded maximum expected demand along each branch or run between laterals.

B. Valves shall be of appropriate type for the usage, shall be clean and in good operating condition, and shall be the same nominal size as pipe.

PART 3 - EXECUTION

3.01 TELEPHONE

A. The Contractor shall install service at time of site mobilization. Installation shall consist of necessary services in accordance with Section 01500 - TEMPORARY FACILITIES.

3.02 ELECTRICITY

A. Install initial services at time of site mobilization. Public Service of Indiana (PSI) will provide power at the southern site boundary adjacent to the existing access road. PSI will provide everything up to and including the meters. (Power will be from two sources - three wire, 480 volt and single-phase, 120 volt, each with its own meter.) Cabinets will be provided; the Contractor shall install them.

B. The Contractor shall bring power to each required use for construction and operations. The Contractor shall modify and extend services as required to support work program.

C. All circuits through the site will be protected either by a ground fault interrupter or an approved grounding system.

D. The Contractor shall be responsible for providing continuous service, including the use of emergency generator power when service is interrupted during site work.

3.03 CLEAN WATER

A. The Contractor shall supply a quantity of clean water required for equipment and facility decontamination, safety and emergency response activities, and potable water needs. Size meter, valves, and piping to provide ample flow.

B. The Contractor shall install service at time of site mobilization.

C. The Contractor shall supply clean water by tank truck and pump. Tank will hold approximately 5,000 gallons and will be kept not less than 35 percent full.

D. The Contractor shall provide pump and piping from clean water tank to decontamination pad and other nonpotable uses.

E. The Contractor shall provide a drinking water source inside trailers for all site workers.

3.04 SANITATION

A. The Contractor shall provide facilities at time of site mobilization.

B. All toilets shall be in compliance with local and state regulations.

C. The Contractor shall provide services to collect and remove sanitary wastes from the Site in an appropriate manner on a regular schedule (weekly unless otherwise specified) and dispose of properly.

1. Clean areas of facilities daily and maintain in sanitary condition.

2. Provide toilet paper, paper towels, and soap in suitable dispensers.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01525 - PROJECT IDENTIFICATION AND SIGNS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section covers the requirements for project identification and project informational signs at the project site.

1.02 QUALITY ASSURANCE

A. Design sign and structure to withstand 50 miles/hour (80 km/hour) wind velocity.

B. Sign Painter: Experienced as a professional sign painter for a minimum 3 years.

C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.03 SUBMITTALS

A. Submit Drawings under provisions of Section 01300 - SUBMITTALS showing sign content, layout, lettering, and colors.

PART 2 - PRODUCTS

2.01 SIGN MATERIALS

A. Structure and Framing: New, wood, structurally adequate.

B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch (19 mm) thick, standard large sizes to minimize joints.

C. Rough Hardware: Galvanized.

D. Paint and Primers: Exterior quality, two coats; sign background of white color.

E. Lettering: Exterior quality paint, contrasting colors as selected.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall install the project identification sign within 30 days after Notice to Proceed is given.

B. Erect at designated location as directed by the Engineer.

C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.

D. Install sign surface plumb and level, with butt joints. Anchor securely.

E. Paint exposed surfaces of sign, supports, and framing.

3.02 PROJECT IDENTIFICATION SIGN

A. One painted sign, 48 square feet area, bottom 6 feet above ground.

B. Content:

1. Project number and title.

2. Names and titles of Authorities.

3. Name of title of Engineer and Consultants.

4. Name of Prime Contractor and major Subcontractors.

3.03 PROJECT INFORMATIONAL SIGNS

A. Paint informational signs of same colors and lettering as Project identification sign, or standard products; size lettering to provide legibility at 100 foot distance.

B. Provide informational signs at each field office and directional signs at the site entrance as well as onsite to direct traffic into and within the Site. Relocate as work progress requires.

3.04 MAINTENANCE

A. Maintain signs and supports clean. Repair deterioration and damage.

B. The signs shall become the property of the ECC Trust at the completion of the project.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01700 - PROJECT RECORD DOCUMENTS/CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall maintain accurate and comprehensive records of all site activities as well as all additions, substitution of materials, variations in work, and any other revisions to the Contract Documents. These records shall be kept in a neat and orderly manner.

1.02 SUBMITTALS

A. The Contractor shall deliver to the Engineer within 30 days of the completion of work, all Project Record Documents. Delivery shall be a condition of final payment.

B. The Project Record Documents shall include all items specified in Section 2.01 of this section.

C. The submittal shall be accompanied by a transmittal letter containing:

1. Date.
2. Project title and address.
3. Contractor's name and address.
4. Title and number of each record.
5. Certification that each document, as submitted, is complete and accurate.
6. Signature of the Contractor or his representative.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The Contractor shall maintain, at the job site, one copy of the following Project Record Documents:

1. As-built drawings showing all variations from the contract drawings.

2. Specifications.

3. Support Plans.

4. Addenda.

5. Change orders.

6. Other modifications to the Contract.

7. Contractor's daily progress or activity reports, including:

    a. Records of all site work.

    b. Daily payment quantities.

    c. Field testing results.

    d. Safety and accident incident reports.

8. Wage records as required for Federal and state funded projects.

9. Technical submittals and change orders.

10. Other items as required by the Contract Documents.

B. The Contractor shall provide safe, onsite storage for all Project Record Documents. This storage shall be available to the Engineer for inspection.

PART 3 - EXECUTION

3.01 RECORDING

A. The Contractor shall clearly label each document as "Project Record."

B. The Contractor shall keep all record documents current.

C. Specifications and Addenda shall be legibly marked up to record changes made by change or field orders, on other matters not originally specified.

D. The Contractor shall maintain an up-to-date chronological index of all project records for review by the Engineer.

E. All documents generated as part of the site preparation and material removal activities are the property of the ECC Trust and shall not be released by the Contractor to the public, news media, or anyone else without prior written permission of the Engineer after consultation with the ECC Trust.

END OF SECTION

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01710 - DEMOBILIZATION

Rev. 2, 3/17/97

PART 1 - GENERAL

1.01 SUMMARY

A. This work shall consist of onsite activities performed by the Contractor subsequent to completion of remedial operations, but prior to project close-out. Demobilization shall be conducted in two phases: construction and operations.

B. Components of this work shall include, but not be limited to, removal of all temporary facilities, sheet pile cutoff walls, construction equipment, and materials; disconnection of utilities; and cleanup of this Site; with the exception of the following support facilities which shall remain onsite:

1. Site security fence and gates.

2. Equipment decontamination and wastewater storage pads.

3. Wastewater treatment and transfer system buildings;

4. Support zone paving and drainage system.

PART 2 - PRODUCTS

A. The Contractor shall provide all labor, materials, and equipment required for the performance of the work.

PART 3 - EXECUTION

3.01 UTILITIES

A. The Contractor shall coordinate with local utilities and shall provide for the disconnection of all utility service. Service lines shall remain onsite.

3.02 TEMPORARY FACILITIES

A. The Contractor shall remove all temporary facilities in accordance with the provisions of Section 01500 - TEMPORARY FACILITIES.

3.03 CONSTRUCTION EQUIPMENT AND MATERIALS

A. The Contractor shall provide for the removal of all construction equipment and materials, with the exception of the site security fence, the decontamination pad, the wastewater storage pad, and the support zone aggregate which shall remain in place for the site operations activities.

B. Sheet Pile Cutoff Walls

Temporary steel pile sheets shall be removed from the excavation area and decontaminated onsite prior to removal by the Contractor.

3.04 CLEANUP

A. The Contractor shall be responsible for the final collection and disposal of all miscellaneous rubbish and debris generated from the site construction and operations.

3.05 OPERATIONS EQUIPMENT AND MATERIALS

A. The Contractor shall provide for the removal of all operations equipment and materials, with the exception of the site security fence, the decontamination pad, the wastewater storage pad, and the support zone aggregate which shall remain in place for the compliance monitoring activities.

B. Soil Vapor Extraction System.

1. The SVE system shall be shut down subsequent to verification of soil cleanup as described in Section 13210 - Site Operations and Maintenance. All above-ground mechanical and electrical equipment and piping shall be removed from the site.

2. Subsurface vacuum extraction well points, trenches and/or sumps shall be grouted in place flush with finished grades.

3. Grout shall be a mixture of bentonite and cement in accordance with Section 02600 - Monitoring Wells. Grout shall extend to the ground surface.

C. Wastewater Treatment System.

1. The wastewater treatment system shall be shut down subsequent to completion of SVE system operations and generation of all site wastewaters, and complete drainage and treatment of the wastewater storage tanks.

2. All above-ground mechanical and electrical equipment and piping shall be removed from the site.

3. Carbon adsorbers shall be drained of liquid prior to site removal by the Contractor.

D. Wastewater Storage and Transfer System.

1. The wastewater storage and transfer system shall be shutdown subsequent to completion of site operation activities and treatment and discharge of the storage tank contents.

2. The tanks including the walls, fixed piping inlets, leak detection sumps, and drains shall be removed by the Contractor.

3. The tank liners shall be removed by the Contractor unless as directed by the Engineer.

4. All subsurface piping shall be drained of liquids and grouted in place flush with finished grade. Grout shall be a mixture of cement and bentonite in accordance with Section 02600 - MONITORING WELLS.

E. Structures and Foundations.

1. All building materials, foundations, and equipment, except for the wastewater treatment and transfer buildings, and the decontamination and wastewater storage pads shall be removed from the site upon completion of SVE system operations and placement of the Stage 2 final cover.

2. Materials that cannot be salvaged by the Contractor shall be disposed of as demobilization wastes as described in Section 02080 - REMEDIAL ACTION GENERATED WASTES.

F. Decontamination.

All construction equipment and materials that have been potentially contaminated during the remediation activities will be decontaminated if they are to be salvaged or reused by the Contractor after demobilization. Decontamination shall be performed on the decontamination pad as described in the General Health and Safety Plan.

3.06 DEMOBILIZATION WASTES

A. Demobilization wastes shall be handled as described in Section 02080 - REMEDIAL ACTION GENERATED WASTES.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02080 - REMEDIAL ACTION GENERATED WASTES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes the requirements for handling of wastes generated during remedial construction, operations and demobilization activities. These wastes shall include decontamination water, personal protective equipment, site mobilization and clearing wastes, drill cuttings, and demobilization wastes.

1.02 RELATED SECTIONS

A. Section 01710 - DEMOBILIZATION

B. Section 02095 - ONSITE WASTE STORAGE

C. Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL

D. Section 13300 - WASTEWATER STORAGE AND TRANSFER SYSTEM

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 DECONTAMINATION WATER

A. The Contractor shall be responsible for collection and disposal of all decontamination water generated from both equipment and personnel decontamination operations.

B. The water will be pumped to the onsite wastewater storage tank T1 for treatment and disposal.

3.02 DECONTAMINATION SOLIDS AND STORAGE TANK SEDIMENTS

A. The Contractor shall be responsible for collection and disposal of all solids generated from both equipment and personnel decontamination operations and operation of the wastewater storage tanks.

B. Solids shall be removed from the decontamination pad surface, trench and manhole sump and placed in the hazardous solid drums as described in Section 02095 - ONSITE WASTE STORAGE. Storage tank sediments shall be removed and temporarily stored onsite in a suitable container as described in Section 02095 - ONSITE WASTE STORAGE.

The solids and sediments shall either be disposed of onsite within the fill in the SVE treatment area or they shall be disposed of offsite at a suitable disposal facility. Onsite disposal shall be acceptable prior to completion of the Stage 1 final cover. The solids and sediments shall be dewatered to remove free liquids by decanting the solid waste drums and containers on the decontamination pad. Additional dewatering may be needed as directed by the Engineer. The solids shall be placed within the SVE treatment area in a soil fill area approved by the Engineer by spreading them in thin lifts not exceeding 12 inches. The solids shall be further air-dried, if needed, and covered with additional soil fill or the Stage 1 final cover, depending on the finished grade of the selected soil fill area.

After construction of the Stage 1 final cover, the solids shall be disposed of offsite. The solids shall be sampled and disposed of at the approved offsite disposal facility as per Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL.

3.03 PERSONAL PROTECTIVE EQUIPMENT

A. The Contractor shall be responsible for collection and disposal of all personal protective equipment generated during site construction and operations activities.

B. All personal protective equipment shall be collected at least daily during construction activities and placed in the onsite hazardous solids container as described in Section 02095 - ONSITE WASTE STORAGE.

C. As the onsite hazardous solids container nears capacity, its contents shall be sampled and disposed of at the approved offsite solid hazardous waste disposal facility as per Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL.

3.04 SITE CLEARING AND MOBILIZATION WASTES

A. The Contractor shall be responsible for collection and disposal of all site clearing material generated during mobilization and construction activities.

B. All site clearing material shall be placed in the onsite non-hazardous solids container.

C. As the onsite non-hazardous solid container nears capacity, its contents shall be sampled and disposed of at the approved offsite waste disposal facility as per Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL.

3.05 DRILL CUTTINGS AND PURGE WATERS

A. The Contractor shall be responsible for the collection and disposal of all drill cuttings and purge waters generated as a result of monitoring well construction and development.

B. All drill cuttings and purge waters shall be placed in the hazardous solids drums as described in Section 02095 - ONSITE WASTE STORAGE. The purge waters and cutting decant waters may be transferred to the wastewater storage tank.

Drill cuttings may be placed in the hazardous solids container, or be left in the hazardous solids drums, depending on their final disposal location.

Drill cuttings shall be disposed of onsite or offsite, as applicable, in accordance with the procedures described in Part 3.02, B.

3.06 DEMOBILIZATION WASTES

A. The Contractor shall be responsible for the collection and disposal of all liquid and solid materials generated as a result of demobilization activities. Demobilization wastes may be generated in two phases of work: construction and operations.

Demobilization wastes may include, but are not limited to, the following items.

1. Rubbish and debris from final cleanup.

2. SVE system equipment and materials, including piping, wiring, mechanical equipment and other related items not salvageable by the Contractor.

3. Wastewater storage and transfer system equipment and materials, not salvageable by the Contractor.

4. Building materials, including the water treatment and SVE system structures (not including the foundations), which are not salvageable by the Contractor.

5. Temporary covers removed from the northern SVE treatment area.

B. All demobilization wastes shall be placed in onsite non-hazardous solids containers as described in Section 02095 - ONSITE WASTE STORAGE.

C. The demobilization wastes shall be sampled and disposed of at the approved offsite waste disposal facility as per Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL.

3.07 WASTE SAMPLING AND ANALYSES

A. Remedial action generated wastes proposed for offsite transportation and disposal shall be sampled and analyzed prior to disposal. Chemical analyses of the wastes shall be performed on a representative sample of the waste stream as necessary to satisfy appropriate regulatory requirements and any additional requirements of the proposed waste disposal facility. The results shall be provided to the Engineer.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02084 - MISCELLANEOUS DEBRIS AREAS

PART 1 - GENERAL

1.01 The Contractor shall remove the existing debris and place it in suitable onsite waste containers for offsite disposal.

1.02 CONDITIONS

A. Miscellaneous debris piles and material are present onsite and have been delineated on the Drawings. The debris consist of soils, vegetation and miscellaneous solids excavated from diversion channel cleaning operations and non-hazardous solid wastes from previous site activities.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 REMOVAL

A. Chemical analyses shall be performed on a representative sample of the debris as necessary to satisfy appropriate regulatory requirements and any additional requirements of the proposed waste disposal facility. The results of the chemical analyses shall be provided to the Engineer.

B. All the materials from the debris areas shall be gathered up and placed in the appropriate onsite container as described in Section02995 - ONSITE WASTE STORAGE. As the container nears capacity, it shall be transported to an offsite solid waste disposal facility as per Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL.

C. During debris removal, the Contractor shall minimize disturbance to the Support Zone.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02095 - ONSITE WASTE STORAGE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes the requirements for temporary onsite storage of solid wastes associated with site construction and operations activities. Wastewaters shall be placed in the onsite wastewater storage system tank designated as T1.

1.02 RELATED SECTIONS

A. Section 02080 - REMEDIAL ACTION GENERATED WASTES

B. Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL

PART 2 - PRODUCTS

2.01 MATERIALS

A. All solid waste containers shall meet all Federal and state requirements.

PART 3 - EXECUTION

3.01 HAZARDOUS SOLIDS CONTAINER

A. The onsite bulk soils container shall be the rolloff type and have a capacity required by the approved offsite solid hazardous waste disposal facility. At a minimum, it shall be watertight, and it must have a cover (such as a tarp).

B. The onsite solid hazardous container shall be used during the construction activities and it shall be placed in the location as shown on the Drawings or at an alternate location approved by the Engineer.

3.02 NON-HAZARDOUS SOLIDS CONTAINER

A. The non-hazardous solids container shall be the rolloff type and have a capacity required by the approved offsite non-hazardous waste disposal facility. At a minimum, it shall be watertight and have a cover (such as a tarp).

B. The non-hazardous solids container shall be used during the construction activities and it shall be placed in the location as shown on the Drawings or at an alternate location approved by the Engineer.

3.03 HAZARDOUS SOLIDS DRUM

A. The Contractor shall supply U.S. DOT 17H-type drums for onsite hazardous waste storage during the operations activities.

B. The drums shall be temporarily placed on the decontamination pad prior to offsite disposal.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02115 - SITE CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Site clearing shall be performed by the Contractor as required during the site construction activities.

B. This item shall consist of the clearing and disposal of trees, stumps, downtimber, brush, undergrowth, and any other vegetation that may hinder any aspect of the construction activities, including the installation of temporary facilities. There are no large trees (greater than three inches) within the site construction area and minimum clearing of site vegetation is anticipated.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 CLEARING

A. The Contractor shall clearly delineate the limits of clearing in the field for approval by the Engineer. Brush and small trees shall be cleared from the areas of the Parcel 45 and Support Zone diversion channels, the southern concrete pad excavation area, and all fill and backfill areas. The Contractor shall not remove or disturb any trees or other vegetation beyond the approved limits. The Contractor shall be responsible for preserving and protecting from injury all trees outside the limits of clearing. Limbs and branches to be trimmed shall be cut close to the trunk or main branch. All material to be cleared shall be removed to grade level.

B. During clearing operations, the Contractor shall minimize disturbance to the existing ground surface within the remedial boundary.

C. During cleaning and construction operations, the Contractor shall protect benchmarks, existing monitoring wells, and existing piezometers from damage or displacement.

3.02 DISPOSAL

A. Burning of the material shall not be permitted.

B. The Contractor shall be responsible for disposing of the materials at an offsite nonhazardous disposal facility as per Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02175 - CULVERTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The extent of culvert work is indicated on the Drawings and by the requirements of this section.

B. Culverts shall be constructed of Class V reinforced concrete pipe, size and length as indicated on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - EARTHWORK.

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM).

1. A 185 - Welded Steel Wire Fabric for Concrete Reinforcement.

2. A 615 - Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.

3. A 443 - Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.

B. Indiana Department of Highways, Standard Specifications, 1988.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for culvert materials and products. Certificates of conformance for all materials shall be submitted assuring conformance with these Specifications. All pipe and appurtenances specified herein shall be covered by a guarantee certificate furnished by the Contractor and signed by an officer of the pipe manufacturers.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Obtain materials from firms regularly engaged in the manufacture of Class V reinforced concrete pipe of types, materials, and sizes required, whose products have been in satisfactory use in similar services for not less than 5 years.

B. Class V culvert pipe presently onsite shall be removed and relocated for reuse. The pipe shall be inspected for damage and shall be reused only if approved by the Engineer.

PART 2 - PRODUCTS

2.01 REINFORCED CONCRETE PIPE

A. Pipe used for culverts shall be Class V heavy duty reinforced concrete pipe meeting the requirements of Section 906.02 of the Indiana Department of Highways Standard Specifications.

B. Culvert pipes shall utilize tongue and groove joints.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Inspect piping before installation to detect apparent defects. Mark defective materials with paint and promptly remove from the Site.

2. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

3. Prepare inlets and outlets as shown on the Drawings. Place aggregate to the thickness and extent as indicated on the Drawings.

4. Existing Class V culvert pipe shall be carefully removed, cleaned of any soil and debris, and inspected for reuse. Damaged or defective pipe shall be disposed in the onsite non-hazardous container per Section 02095 - ONSITE WASTE STORAGE.

B. Laying Pipe:

1. Pipes shall be laid true to the lines and grades shown on the Drawings. The grade shown on the profile is the invert to which the work must conform. Work not conforming to the grade shall be corrected by the Contractor at his own expense. The locations of the proposed lines are shown on the Drawings. Approximate depths are shown on the Drawings.

2. After the trench has been brought to the proper grade as heretofore specified, the pipe and fittings shall be laid. Care shall be taken to lay the pipe to true lines and grades. Every pipe laid shall be tested as to grade and alignment. Care must be taken to fit the joints together properly so that the centers of the pipes shall be in one and the same straight line, and so as to give an opening of even thickness, all around.

3. Carefully handle and lower pipe into the trench. Take special care in laying pipe, to ensure that each length abuts against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the bottom half of the pipe line. No wedging or blocking will be permitted in laying any pipe unless by written order or permission from the Engineer.

4. Bed each pipe section on a solid foundation before making successive joints. Bring no pipe section into position until the preceding length has been thoroughly embedded and secured in place. Correct any defects due to settlement at Contractor's own expense. All pipe bedding shall be as shown on the Drawings.

5. Use proper and suitable tools and appliances for the safe and convenient handling and laying of pipes.

6. Whenever a pipe requires cutting, to fit into the line or to bring it to the required location, cut the pipe in a satisfactory manner so as to leave a smooth end, without extra compensation.

7. Keep the excavation in which pipe is being laid free from water and make no joint under water. Do not allow water to rise in the excavation until the joint material has received its set. Use the greatest care to secure watertightness and to prevent damage to, or disturbance of the joints during the refilling process, or at any time. After pipes have been laid and the joints have been made, allow no walking on or working over them, except such as may be necessary in tamping, until there is a aggregate covering over their top.

8. Lay no pipe upon a foundation into which frost has penetrated nor at any time when the Engineer shall deem that there is danger of the formation of ice or other penetration of frost at the bottom of the excavation. Work may proceed during subfreezing conditions, at the discretion of the Engineer, provided that the minimum length of open trench and promptness of refilling are observed.

3.02 MAINTENANCE

A. The Contractor shall inspect each culvert and its components periodically during construction and operations to ensure that the culvert is in good condition with no cracks and/or defects present.

B. The Contractor shall clean culverts so that flow is not impeded by sedimentation buildup.

C. The Contractor shall also inspect the aggregate to ensure that it is in place to the required extent and thickness.

D. The Contractor shall be responsible for maintenance repairs as needed at no additional cost to the ECC Trust.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02185 - SUMP GROUTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The existing ECC sump in the southern concrete pad area shall be grouted in the sump zone extending from beneath the proposed excavation floor to the top of the sand water-bearing zone to reduce seepage into the excavation.

B. The Contractor shall provide all labor equipment and materials as needed to perform the sump grouting. The typical grout area is shown on the Drawings.

1.02 SUBMITTALS

A. Manufacturer's product data and certifications.

B. The Contractor shall submit a Sump Investigation Plan in accordance with Section 01300 - SUBMITTALS.

C. The Contractor shall submit a Sump Grouting Plan in accordance with Section 01300 - SUBMITTALS.

D. Grouting Report.

1.03 REFERENCES

A. Marsh Viscosity Test.

B. Standard Penetration Test (SPT), Test Method for Penetration, Test and Split - Barrel Sampling of Soils, ASTM D 1596.

C. Time of Setting of Hydraulic Cement by Vicat Needle, ASTM C 191-82.

PART 2 - PRODUCTS

2.01 GROUT

A. Grout shall be a mixture of Type III Portland Cement and clean, potable water. The water:cement ratio, by volume, shall be 3 to 1 or less (thicker). Thinner grouts shall be used if determined to be feasible based on initial grouting in the field.

2.02 GROUT MIXER

A. A colloidal mixer shall be provided that produces a uniformly mixed and dispersed grout. The mixer shall have sufficient speed and shear to prevent formation of lumps and clogging of the pumping and injection equipment. Mixing periods of greater than one minute shall be prohibited to avoid excess heat build-up. Return flow to the mixer shall be tangential to the tank.

2.03 GROUT PUMP

A. Grout shall be pumped by a progressing helical cavity-type pump, such as manufactured by ABS of Moyno.

PART 3 - EXECUTION

3.01 TEST BORINGS

A. The Contractor shall drill test borings into the sump area prior to grouting to determine the sump dimensions, depth and insitu materials. Continuous samples shall be taken and boring logs shall be recorded according to the Unified Soil Classification System (USGS).

3.02 GROUT TESTING

A. Laboratory tests shall be performed on proposed grout mixes to determine their set times and viscosity. Each grout mix proposed shall have 2 of each test performed. The grout test results shall be included in the Sump Grouting Plan.

3.03 GROUTING METHOD

A. Grouting shall be accomplished by the pressure injection method. Grouting shall be accomplished by the upstage injection method using a blanket grouting procedure.

B. Grouting shall be performed after dewatering of the concrete pad and subbase aggregate.

C. Grout hole spacing shall be at a maximum of 10 feet. Grouting sequence shall be from the sump perimeter towards the center on a pattern as determined by the Contractor. Closer spacings may be required depending on the results of the water pressure test and confirmatory borings described in Part 3.04.

D. Maximum grout injection pressure shall be 1 psi per foot of depth.

E. The grouting of any hole in which a mix of 3 to 1 or thicker is being used shall not be considered complete until the hole refuses to take grout at the maximum pressure required for that stage of that hole.

3.04 QUALITY CONTROL

A. Field tests of grout mix viscosity shall be performed for each grout hole or on a minimum 4-hour interval during grouting. The samples shall be taken form the grout return line and shall be representative of the grouting flowing into the hole.

B. Water Pressure Test. A minimum of 1 grout hole water pressure test shall be performed prior to grouting to estimate the baseline grout take. Potable water shall be used during the test.

C. Confirmatory Borings. A minimum of 3 confirmatory test borings shall be drilled into the grouted zone between grout holes. The borings shall be drilled a minimum 24 hours after completion of grouting. Continuous samples shall be taken from the ground surface through the grouted zone using NX core barrels. Drilling method shall be fluid rotary using water or drilling mud depending on borehole conditions.

If the boring samples indicate that 90% or less of the core sample has not been filled with grout, as measured by the ungrouted sample length over the total length of the sampler, then additional grouting shall be performed on a series of groutholes halfway between the first set of groutholes.

D. Documentation. The Contractor shall record the following information for submittal to the Engineer in the Grouting Report:

1. Grout hole location survey and drilling logs.

2. Water pressure test results.

3. Grout take per hole.

4. Quantities of grout and water used.

5. Special problems, field changes and delays.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02186 - CONCRETE PAD DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials and equipment required to demolish the existing concrete pads and foundations as shown on the drawings. This section includes complete removal of the concrete slabs, foundations, subbase aggregate and miscellaneous appurtenances encountered during demolition activities.

B. The concrete pads are estimated to be 4 inches in thickness and are not reinforced. The southern concrete pad subbase consists of 12 - 18 inches of coarse gravel aggregate. No information is available on building foundations or the other concrete pad subbases.

C. All items removed during demolition shall be crushed onsite. Crushing operations shall be performed within the Remedial Boundary area. The crushed product shall be placed onsite in the northern fill area for subsequent vapor extraction treatment.

1.02 RELATED SECTIONS

A. Section 02210 - CONSTRUCTION DEWATERING

B. Section 13100 - SOIL VAPOR EXTRACTION SYSTEM

1.03 SUBMITTALS

A. The Contractor shall submit a Concrete Pad Demolition Plan in accordance with Section 01300 - SUBMITTALS.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 CONCRETE PAD DEMOLITION

A. Concrete pad demolition shall be performed to the limits shown on the Drawings. Demolition shall be to a depth of a minimum 3 inches below the concrete slab and foundations, or if present, to the bottom of the aggregate underlying the slabs and foundations.

B. The concrete pads and subbase aggregate shall be dewatered prior to demolition so as not to cause demolition materials and crushed product to produce excessive water during crushing activities.

C. Excavation and holes caused by concrete slab foundation removal shall be backfilled to grade in accordance with Section 02200 - EARTHWORK.

D. The demolition materials shall be crushed into pieces not exceeding a nominal 3 inch size.

3.02 NOISE AND DUST CONTROL

A. The Contractor shall take all possible measures to minimize the amount of dust and noise resulting from demolition activity.

B. Particulate and VOC monitoring shall be conducted during demolition activities in accordance with Section 01396 - AIR MONITORING.

3.03 CRUSHED PRODUCT PLACEMENT

A. Crushed product shall be placed in the northern fill area within the remedial boundary as shown on the Drawings. The product shall be placed to the finished elevations and grades as shown on the Drawings.

B. The crushed product shall be placed in 12 inch thick lifts and compacted by a minimum two passes of a vibratory type compactor with a minimum operating weight of 30,000 pounds and an applied dynamic force of 60,000 pounds.

C. Crushed product fill areas shall be covered daily with temporary covers as described in Section 02283 - TEMPORARY COVERS.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02190 - WELL ABANDONMENT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials and equipment required to abandon existing monitoring wells as shown on the Drawings. This section includes complete removal of the well stickup and protective casing and sealing of the well pipe, screen and borehole remaining beneath the ground surface.

B. Access to some of the drilling locations may require the use of all-terrain or tracked vehicles. The Contractor is responsible for providing all equipment necessary to gain access to the drilling locations.

C. The Contractor is responsible for providing all equipment necessary for temporary storage and transportation of water.

1.02 SUBMITTALS

A. Manufacturer's Product Data.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Type I Portland Cement Grout.

B. Bentonite Clay.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall verify the site conditions and locations of the existing monitoring wells identified in this section.

B. The following existing monitoring wells shall be abandoned. The locations are shown on the Drawings. The Contractor shall verify the locations of these wells in the field and report any discrepancies to the Engineer.

Monitoring Well Number	Total Depth (Feet)
ECC 2A	27.5
ECC 3A	15.0
ECC 3C	147.3
ECC 4C	159.0
ECC 5A	23.7
ECC 7A	22.0
ECC 8A	25.0
ECC 9A	25.0
ECC 10A	20.0
ECC 11A	14.0
ECC 12 (sump)	15.0
ECC 14	25.0
ECC 16	14.0

Well pipe is 2-inch PVC (SCH 40) and well screens are 5 foot long 0.020 inch slot PVC. All deep wells ("C" designation) have schedule 80 PVC pipe and screens.

3.02 ABANDONMENT

A. Clear the well of pump, pipe and all obstruction, as needed.

B. Remove the locking cap and protective steel casing. Cut off the well pipe at or below the ground surface.

C. The screen shall be filled with sterilized sand or gravel which shall not extend above the top of the screen.

The well pipe shall be filled with a cement bentonite grout, or neat cement. Concrete may not be used in a screened interval but may be used within the pipe. All of the sealing materials shall be introduced through a tremie pipe discharging at the bottom of the space to be filled in order to prevent dilution of the sealing material.

3.03 DECONTAMINATION

A. All equipment placed with in the monitoring well or working inside of the remedial boundary shall be decontaminated using high pressure hot water or steam at the onsite decontamination pad.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02115 - SITE CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Site clearing shall be performed by the Contractor as required during the site construction activities.

B. This item shall consist of the clearing and disposal of trees, stumps, downtimber, brush, undergrowth, and any other vegetation that may hinder any aspect of the construction activities, including the installation of temporary facilities. There are no large trees (greater than three inches) within the site construction area and minimum clearing of site vegetation is anticipated.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 CLEARING

A. The Contractor shall clearly delineate the limits of clearing in the field for approval by the Engineer. Brush and small trees shall be cleared from the areas of the Parcel 45 and Support Zone diversion channels, the southern concrete pad excavation area, and all fill and backfill areas. The Contractor shall not remove or disturb any trees or other vegetation beyond the approved limits. The Contractor shall be responsible for preserving and protecting from injury all trees outside the limits of clearing. Limbs and branches to be trimmed shall be cut close to the trunk or main branch. All material to be cleared shall be removed to grade level.

B. During clearing operations, the Contractor shall minimize disturbance to the existing ground surface within the remedial boundary.

C. During cleaning and construction operations, the Contractor shall protect benchmarks, existing monitoring wells, and existing piezometers from damage or displacement.

3.02 DISPOSAL

A. Burning of the material shall not be permitted.

B. The Contractor shall be responsible for disposing of the materials at an offsite nonhazardous disposal facility as per Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02200 - EARTHWORK

(Rev. 2, 2/7/97)

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall make all excavations for the southern concrete pad soils, the onsite fill areas, and the diversion channels and culverts, to the dimensions and levels shown on the Drawings or as required by the Engineer. Work under this section includes excavation of all materials encountered, trenching, shoring (as needed), maintenance of excavation, backfill, fill, compaction, and grading.

B. Before commencing any operation, all required grades and lines shall be staked out by a Land Surveyor licensed in the State of Indiana, hired by the Contractor, and approved by the ECC Trust. The Contractor is advised that lines and grades, as shown on the Drawings, are subject to change. Although it is the intention to adhere to that which is shown in the plans, the ECC Trust reserve the right to make changes in lines and grades when such changes may be necessary or advantageous.

C. The excavation, backfill, and compaction shall be carried out in such a manner as to eliminate any possibility of undermining or disturbing the foundations of any existing structure or any work previously completed under this Contract, or as herein specified.

D. The Contractor shall verify all existing topography, site features locations, and dimensions prior to commencing the work. Any discrepancies shall be immediately reported to the Engineer.

E. Air monitoring shall be conducted during all excavation and fill placement activities related to the southern concrete pad.

1.02 SITE INFORMATION

A. Existing grades and other site information shown on the applicable Contract Drawings are approximate. The ECC Trust do not guarantee that the grades shown will not vary from the actual site conditions. The Contractor must make his own field investigations to determine all conditions affecting the work to be done and materials needed and make his bid in sole reliance thereon.

1.03 RELATED SECTIONS

A. Section 01396 - AIR MONITORING

B. Section 02185 - SUMP GROUTING

C. Section 02205 - SHEET PILE CUTOFF WALL

D. Section 02210 - CONSTRUCTION DEWATERING

E. Section 02281 - HDPE LINER

1.04 REFERENCES

A. ASTM D422- Particle Size Analysis of Soils.

B. ASTM D1557 - Moisture-Density Relations of Soils and Soil-Aggregate Mixture using 10 lb (4.54 kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor Test).

C. ASTM D1556 - Density of Soil in Place by the Sand-Cone Method.

D. ASTM D1587 - Thin-walled Tube Sampling of Soils.

E. ASTM D2922 - Density of Soil in Place by Nuclear Methods.

F. ASTM D5084 - Hydraulic Conductivity of Saturated Porous Material.

G. ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils.

H. Enviro-Chem Remedial Action QAPP, Borrow Soil Chemical Analyses.

1.05 SUBMITTALS

A. Submit to the Engineer a list of fill and backfill materials which the Contractor proposes to use, at least one (1) week before the Contractor commences delivery of the materials to the site. Materials shall not be delivered to the site until approved by the Engineer. As delivered, the materials shall be equal in all respects to the samples.

B. Submit borrow soil select material samples of at least 70 pounds to the Engineer. Material samples shall be appropriate containerized and neatly labeled with the name of material, size, supplier and other information, as appropriate, to clearly identify samples.

C. Test results shall be submitted to the Engineer by the Contractor certifying that fill and backfill materials meet the requirements as specified in Part 2 of this section. These results shall include those listed in Part 1.04 as applicable for the specific material.

Select material for the Stage 1 and Stage 2 final cover shall be tested to establish a correlation between maximum dry density and hydraulic conductivity to permit the use of field density measurements (in addition to laboratory testing) for determining the cover permeability requirement. Initial submittal shall be delivered simultaneously with the list of materials required in Item A of this subpart.

D. Frequency of test results and submittals by the Contractor shall be in accordance with the CQAP and QAPP, Sections 01400 and 01392, respectively.

E. Excavation Plan outlining the Contractor's approach, schedule, and equipment for excavation, dewatering and backfill of the southern concrete pad soil area. The plan shall include a description of methods for transporting borrow soils from the borrow area(s) to the site.

F. Pre-Construction Test Drilling Plan as required by Section 02205 - SHEET PILE CUTOFF WALL.

G. Borrow Area.

The NSL Landfill Borrow Area east of the site is the preferred borrow area for suitable and select soil materials. The Enviro-Chem Trustees under a July, 1993 Access and Settlement Agreement have a right to use 40,000 cubic yards of "clay till" soils from the borrow area.

The NSL Borrow Area construction is expected to be completed in the spring of 1997. The volume and suitability of soil materials remaining in the NSL Landfill Borrow Area shall be verified by the Contractor. The Enviro-Chem Trustees shall assist the Contractor in obtaining access to the borrow area for the purposes of obtaining soil samples.

Legal access to the NSL Borrow Area shall be obtained by the Enviro-Chem Trustees as needed to use the area for the Enviro-Chem Site. Physical access, such as haul roads, drainage systems and other construction as needed shall be the responsibility of the Contractor. The access route from the NSL Borrow Area to the Enviro-Chem Site shall be as directed by the Engineer.

The Contractor shall provide to the Engineer for approval a Grading and Erosion Control Plan for use of the NSL Borrow Area. The plan shall be provided at least one (1) week before the Contractor starts work in the borrow area. After completion of all work in the borrow area, an as-built final grade topographic map shall be provided to the Engineer as part of the Final Certification of Completion Report required by the Construction Quality Assurance Plan.

The Contractor may use an alternate borrow area instead of the NSL Borrow Area, or if the NSL Borrow Area is not suitable. The Contractor shall provide all required soil information to the Engineer, including a plan for transporting borrow soils to the site as required by this section.

1.06 PROTECTION

A. Extreme care shall be exercised to avoid existing facilities, utilities, fences, and private property that are to remain and all necessary precautions taken to preclude damage to these items. Any damages to those items as a result of work performed by the Contractor shall be repaired by the Contractor at his own expense. The Contractor's attention is directed to Section 01395 - ENVIRONMENTAL CONTROL.

B. Preserving Survey Markers: Any existing property boundary markers, control points, and datum elevations markers or bench marks shall be preserved, and all such established survey points which are displaced or destroyed by the Contractor shall be replaced by the Contractor with all expenses for such replacement paid by the Contractor.

PART 2 - PRODUCTS

2.01 SAFETY REQUIREMENTS

A. The Contractor shall provide and maintain barricades, signs, lights, shelters, etc., required for the protection of personnel, materials, and property. Barricades, etc., shall conform with all codes and regulations, and shall be lighted at night with lanterns and reflectorized paint as directed or required for safety, and shall be removed upon completion of the Contract.

B. All work shall conform to Occupational Safety and Health Administration requirements, including those contained in 29 CFR Section 1910 and 29 CFR Section 1926.

2.02 FILL AND BACKFILL MATERIALS

A. Suitable Material.

1. Suitable material shall be obtained from natural deposits and shall be unprocessed except for the removal of unacceptable material and rocks larger than 6 inches in any dimension. It shall be free of topsoil, vegetation, roots, lumber, metal, refuse, coal waste, slag, and cinders.

2. Suitable material shall consist of a well-graded mixture of stones or rock fragments and particles with 95 to 100 percent passing the 3-inch sieve and 25 to 70 percent passing the No. 4 sieve. Suitable material shall be used for general fill or subgrade.

3. Suitable material shall be obtained form the borrow area as chosen by the Contractor and approved by the Engineer. Surplus suitable material shall be returned to the borrow area.

B. Select Material.

1. Select material shall be a clayey fine-grained material obtained from natural deposits and unprocessed except for the removal of unacceptable material and rock fragments larger than 1 inch in any dimension. It shall be free of topsoil, vegetation, roots, lumber, metal, refuse, coal waste, slag and cinders.

2. Select material shall consist of a well-graded mixture of soils with 100 percent passing the 1-inch sieve, a minimum 80 percent passing the No. 10 (sand) sieve, and a minimum 50 percent passing the No. 200 sieve. Select material shall have unified soil classification type CL, ML or CL-ML.

3. Select material shall be used for backfill of the southern concrete pad excavation, backfill of existing drainage channels, construction of the clay cover key, and the cap low-permeability soil layers.

4. Select material shall be obtained from the borrow area as chosen by the contractor and approved by the Engineer. Surplus select material shall be returned to the borrow area.

5. Select material used for the cap shall be capable of being compacted to the required density to achieve a hydraulic conductivity of 1×10^{-6} cm/second or less.

C. Topsoil.

1. Topsoil shall be loose friable soil, free from lumps, clay, toxic substances, sticks, debris, vegetation, stones over 2-inches in maximum dimension, or other material detrimental to proper development of vegetative growth.

2. Topsoil shall be spread over the areas to be seeded and shall be finely graded so as to be suitable for sowing, as applicable. Topsoil shall not be taken from a source known to contain any of the noxious weeds defined as such in the Indiana State Seed Law.

3. Topsoil shall have a pH value of 6.2 to 7.4. Testing for pH value shall be performed in the field in accordance with the procedure set out in the Purdue University Agricultural Experiment Station Bulletin No. 635 or in a qualified laboratory in accordance with the procedure set out in the Cornell Experiment Station Bulletin No. 960, using a one-to-one Soil-Water Suspension. Agricultural limestone may be added to topsoil in order to raise the pH to meet specification requirements.

D. Unsuitable Material.

1. Material which is unacceptable for use as select or suitable material, including excessively wet soils, vegetation, frozen materials, wastes, debris, and any other material as determined by the Engineer.

E. Structural Aggregate.

1. IDOH Nos. 8 or 9 crushed limestone, dolomite or gravel.

PART 3 - EXECUTION

3.01 GENERAL

A. Before commencing any operations, all required grades and lines shall be staked out by a land surveyor, licensed in the State of Indiana, hired by the Contractor and approved by the Engineer.

B. The Contractor shall protect temporarily unfinished work such as open trenches and excavations and newly graded areas from traffic and erosion and shall keep area free of trash and debris for the duration of the Contract.

C. The Contractor shall repair and re-establish grades as necessary in settled, eroded, and rutted fill and excavation areas to the required elevations, slopes, and tolerances.

D. Pooled water shall be removed from all fill and backfill areas prior to placement of the fill and backfill.

3.02 SOUTHERN CONCRETE PAD SOIL EXCAVATION AND BACKFILL

A. Excavation of soils from the southern concrete pad area shall not commence until air monitoring stations are in-place in accordance with Section 01396 - AIR MONITORING.

B. Soils shall be excavated per the schedule and sequence as described in the Contractor's approved Excavation Plan. The Contractor shall take special precautions for worker safety as outlined in the HASP when working in the excavation because of potential contamination.

The soils in the southern concrete pad area shall be excavated to the elevations and grade as shown as the Drawings. Nominal excavation depth is 9 feet below the surface of the existing concrete pad. Supplemental excavation may be required as described in Section F based on the results of exit soil sampling.

C. **Before excavation begins, an Indiana-registered engineer specializing in geotechnical engineering will provide to the Engineer, a written determination of the maximum safe depth for excavation in the Concrete Pad Area for review and concurrence by U.S. EPA and IDEM.**

D. The excavation within the sheet pile cutoff wall shall be performed first. Excavation may commence prior to dewatering of the sand water-bearing zone to the safe hydrostatic pressure level as described in Section 02210 - CONSTRUCTION DEWATERING; however, the depth of the excavation shall not exceed 6 feet (below the surface of the concrete pad) until dewatering has lowered the hydrostatic pressure to the safe level.

Soils shall be excavated to the sides of the cutoff wall and to the floor elevations as shown on the Drawings. Exit soil sampling will be performed by others as described in Section F.

E. The southern concrete pad area outside of the sheet pile cutoff wall shall be excavated by open cut. The open excavation side slopes will be sloped at a minimum safe angle per OSHA requirements, except for the northern face which will be cut at a flatter slope to accommodate the HDPE liner. Excavation slopes shall be ¾H:1V or flatter, except for the northern slope which shall be 3H:1V.

The HDPE liner shall be placed inside of the cutoff wall prior to removal of the sheet piles as indicated on the Drawings.

The north slope of the open excavation shall extend north of the sheet pile cutoff wall to allow placement of the HDPE liner. This area shall be excavated prior to pulling the north sheet pile wall. This portion of the HDPE liner shall be placed after removal of the sheet piles.

F. Supplemental Excavation Assessment and Exit Soil Sampling.

1. A supplemental excavation assessment will be performed in the excavation floor areas when the target depth of 9 feet has been reached in that area. Deeper excavations may be implemented and they will be performed if necessary, based on the assessment procedure described in revised Exhibit A, Section 2.1.1. The assessments will be performed in each excavation area corresponding to the excavation staging as proposed by the Contractor and approved by the Enviro-Chem Trustee's Engineer. At a minimum, two excavation stages will be required. These include the cutoff wall area and the western pad area open cut. Supplemental excavations, if performed, will not exceed the maximum safe excavation depth determined as described in Part 3.02C. Once the excavation stage is completed, including any supplemental excavations, exit soil sampling may be conducted by U.S. EPA, if they desire to do so, on the excavation floor and sides. Samples shall be split with the Enviro-Chem Trustee's Engineer.

2. If exit soil sampling shows that the sidewalls are still contaminated above RCRA clean closure criteria, the Trustees will determine the extent of sidewall contamination and the extent to which the excavation can be practicably extended. If contamination exists beyond the boundaries where excavation can reasonably be extended, it will be addressed by extending the RCRA complaint cover over the lateral extent of the contamination. This agreement applies up to but not beyond unnamed ditch to the east, up to but not beyond the support zone to the west, and up to but not beyond the roadway to the south.

3. The methodology for assessment of supplemental excavations and exit soil sampling will be as follows:

    a. Visual Inspection – A visual inspection will be performed of the excavation floor at the 9-foot level for indicators of contamination, including soil staining, oily or non-aqueous chemical product presence, or semi-solid or solid waste product presence. Any visible contamination remaining at the 9-foot level will be excavated, but any such excavation will not exceed the maximum safe depth as determined in accordance with Part 3.02C.

b. Field Readings – In addition, after excavation to the 9-foot level, field readings will be taken. If there is agreement among the representatives of the Enviro-Chem Trustees, U.S. EPA, and IDEM, then additional excavation will be undertaken based on the results of field instrumentation, provided that the excavation is deemed safe and practicable in accordance with the maximum safe depth as determined in accordance with Part 3.02C. In the event that the representative of the ECC Trustees does not agree, no further excavation will be performed except for the removal of visible contamination to the extent required by Item 1 above.

c. Exit Soil Sampling and Field Analyses – Soil samples may be taken by U.S. EPA/IDEM over the floor and sidewalls of each excavation stage at locations determined by U.S. EPA/IDEM in cooperation with the Trustees. Each excavation stage will be backfilled as soon as possible after soil samples have been taken without awaiting results. The exit soil sample analytical results, if obtained, will be analyzed to determine the need for capping the excavation area (see Section 2.2.2.10).

The Trustees will provide reasonable assistance to the Agencies in their collection of these exit samples, including sampling of the sidewalls of the excavation. The Agencies have also agreed to conduct exit sample collection promptly after each excavation stage so as not to delay the backfilling process. Any samples taken will be split with the Trustees.

In order for U.S. EPA and/or its consultant to collect exit sampling the completed excavation area will remain open for one day before backfilling. it was also agreed that the excavation area will remain open for a second day if samples are not collected on the first day. The request to keep the excavation open for a second day will be made by U.S. EPA to the Settling Defendants either in writing or verbally.

4. Sidewall Soil Sampling.

a. With respect to excavation sidewall soil sampling and sidewall soil excavation, if any, see the Sidewall Soil Sampling Protocol, Subpart 3.07 of this specification.

G. Air Monitoring and Emission Suppression Measures.

1. Air Monitoring shall be performed by the Contractor during the course of all excavation activities in accordance with Section 01396 - AIR MONITORING, and the Air Monitoring Plan.

2. Vapor and/or particulate emission suppression measures shall be initiated by the Contractor if target VOC or particulate criteria described in the Air Monitoring Plan are realized during excavation activities. Water shall not be used unless specifically approved by the Engineer.

3. The suppression agent for VOC emissions shall be Aqueous Film Forming Foam (AFFF) foam, or equivalent, manufactured by:

   3M Corporation
   Minneapolis, Minnesota

4. The foam shall be applied over the excavation area as needed to reduce emissions using materials and equipment as recommended by the manufacturer. Suppression measures shall be stopped only as directed by the Engineer.

H. Backfill and Compaction.

1. The excavation shall be backfilled with select material as described in Section 2.02(B). The backfill shall be placed in 12-inch thick, or less, lifts and compacted to 90 percent of the maximum dry density as determined by compaction tests.

2. Backfilling operations shall immediately follow behind the excavation activities once exit soil sampling is completed and the HDPE liner is installed. Backfill will be undertaken at the earliest possible time to minimize the risk of rainfall and runoff accumulation in the working excavation. Backfill will be completed to the elevation and grades as shown on the Drawings.

3. Prior to placement of fill, the surface of the subgrade shall be examined by the Engineer to determine the presence, if any, of ruts, disturbed ground, wet spots, soft areas, organic matter, or other features undesirable in a subgrade. Undesirable features shall be removed before placing fill.

4. Each layer of material shall be compacted by the use of approved means so as to secure a dense, stable, and thoroughly compacted mass. At such points as cannot be reached by mobile, power-driven compaction equipment, or

where such equipment is not permitted, the materials shall be thoroughly compacted by the use of other approved methods.

5. Previously placed or new materials shall be moistened by sprinkling, if required, to ensure proper bond and compaction. No compacting shall be done when the material is too wet, from either rain or too great an application of water, to compact it properly; at such times, the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions shall be taken as may be necessary to obtain proper compaction.

I. Work Schedule.

1. The Contractor shall work two 8-hour shifts (16 hours per day) over a minimum 5-day work week to complete the excavation and backfill of the southern concrete pad soil excavation.

2. Temporary work lighting and support facilities shall be provided by the Contractor as needed to complete the work.

3.03 NORTHERN FILL AREA

A. Preparation.

1. The northern fill area for crushed product and southern concrete pad soils shall be graded to construct a final cover foundation key prior to contaminated fill placement as shown in the Drawings.

2. The key footprint area shall be stripped of vegetation and unsuitable material prior to placement of the key fill. Site clearing wastes shall be disposed of as described in Section 02115 - SITE CLEARING. The key will be constructed with select material as described in Section 2.02(B). The fill shall be placed in 12-inch thick lifts and compacted to 90 percent of the maximum dry density as determined by compaction tests.

B. Contaminated Fill Placement.

1. Excavated soils from the southern concrete pad area and crushed concrete/aggregate product shall be placed in the segregated areas in the northern fill area for SVE treatment as shown on the Drawings.

2. The fill shall be placed in 12-inch thick lifts and compacted by the incidental movement of the earthmoving equipment.

3. The fill shall be placed to the limits, grade and elevations as shown on the Drawings. Fill in excess of the volume as indicated on the Drawings shall be placed in the northern fill area by extending the southern end of the fill in a uniform manner as needed to provided the additional capacity. In no circumstances shall the fill be placed higher than the elevations shown on the Drawings unless specifically directed by the Engineer.

C. Temporary Cover.

1. Temporary daily covers shall be placed over the entire area of fill that has not been covered with the Stage 1 final cover soil. Temporary covers shall be installed as described in Section 02282 - TEMPORARY COVERS.

3.04 STOCKPILES

A. When material satisfactory for fill and backfilling and in quantities sufficient for those purposes is stockpiled, including contaminated soils and crushed product, stockpiling shall be in an orderly manner at a location specified by the Engineer. The Engineer will specify stockpile locations so as to minimize interference with construction operations. The Contractor shall protect the stockpiles from excessive rainwater and erosion.

3.05 DIVERSION CHANNELS AND CULVERTS

A. Diversion channels shall be excavated in the Support Zone to the lines and grades as shown on the Drawings. Excavated materials shall be placed in the northern fill area per Section 3.03.

Debris excavated from the Parcel 45 diversion channel shall be placed in onsite containers per Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL.

B. Existing support zone diversion channels that shall be relocated shall be backfilled with suitable material to existing grade as described in Section 2.02(A).

The suitable material shall be placed in 12-inch thick lifts and compacted to 90 percent of the maximum dry density as determined by compaction tests.

C. Culverts shall be placed in diversion channels at the lines and invert elevations as shown in the Drawings and in accordance with Section 02175 - CULVERTS.

Culverts shall have a bedding and backfill consisting of structural aggregate as shown on the Drawings. The backfill shall be placed in approximately 6-inch horizontal layers and compacted with a minimum two passes of a vibratory plate compactor.

3.06 RCRA-COMPLIANT FINAL COVER

A. The Contractor shall place a final cover RCRA-compliant over the SVE treatment areas in the northern fill and central areas of the site as shown on the Drawings. The cover will be placed in two stages as follows:

Stage 1 - SVE operations cover installed after the contaminated soil and crushed concrete/aggregate fill is placed to final grade.

Stage 2 - Final cover installed after completion of SVE operations and verification of soil cleanup (approximately 1 to 3 years after placement of the Stage 1 cover).

B. Southern Concrete Pad Area.

1. The cover type in the southern concrete pad excavation area will depend on the results of the exit soil sampling conducted in the excavation. If the exit samples do not exceed the RCRA clean closure standards, then the excavation area will be backfilled as described in Section 3.02(H) and covered with 12 inches of topsoil to the grades as shown on the Drawings. If the exit samples exceed the clean closure standards, then the excavation area will be backfilled with the Stage 1 and 2 final cover as described herein. The Stage 1 cover, if necessary, shall be installed immediately after backfill is placed to finished grade. The Stage 2 final cover, if necessary, shall be installed concurrent with the Stage 2 final cover placement in the SVE operations area.

2. The specific area to be capped will be as directed by the Enviro-Chem Trustees Engineer based on the exit soil sampling results and consistent with Exhibit A of the Consent Decree. Any RCRA-compliant cover or covers placed over the excavation area will be continuous with the RCRA-compliant cover in the northern part of the site.

C. Stage 1 Final Cover.

1. The first stage cover shall consist of a minimum of 3-foot of compacted, select material and 1 foot of top soil to support vegetation. The final grading plan will ensure a minimum clover slope of 3 percent. The Stage 1 cover shall be placed sequentially as the northern fill area reaches finished grade.

D. Stage 2 Final Cover.

1. The second stage cover shall consist of a minimum of 3 foot of select material, a geocomposite drainage net, 1 foot of suitable material, and 1 foot

of topsoil to support vegetation. The in-place 3 foot select material layer of the Stage 1 cover shall be used for the Stage 2 cover. The Stage 1 topsoil shall be removed to allow placement of the remaining components of the Stage 2 cover. The Stage 1 topsoil shall be temporarily stockpiled for reuse as the Stage 2 topsoil layer.

E. Permeability Requirement.

1. The select material layer of the Stage 1 and Stage 2 final covers shall have a minimum hydraulic conductivity of 1×10^{-6} cm/sec.

2. The contractor shall provide samples and test results prior to construction to demonstrate the suitability of the select material as described in Parts 1.04 and 1.05 and Section 01300 - SUBMITTALS.

3. The Contractor shall also take undisturbed field samples for permeability testing of the select material RCRA cover. ASTM Method D-5084, Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeator shall be used. Five undisturbed core samples shall be taken from each 6-inch lift from locations evenly spaced over the site following the procedures outlined in ASTM Method D-1587, Thin-Walled Tube Sampling of Soils. Sampling will be staged within each lift as needed to minimize work delays. Sample testing will be performed on a fast-turnaround basis (1-3 days) to further minimize delays in work.

   After samples have been extracted from the compacted select material layer, the open corehole shall be backfilled with bentonite pellets. The pellets shall be 3/4-inch diameter, or less, and shall be paced in the corehole in 6-inch lifts and lightly tamped until the hole is filled to the top of the cover layer fill.

F. Placing Select Material Fill.

1. Fill lifts - Unless otherwise specified, all select material fill shall be placed in approximately horizontal, 6-inch thick compacted lifts. So far as practical, each layer of materials shall extend the entire length and width of the area being filled.

   a. Before compaction is started, the material shall be leveled by means of bulldozers, blade graders, or other equipment.

   b. The use of dragline excavators or similar equipment which excavate and deposit material in large unit masses will not be permitted unless all materials excavated are spread in the manner and to the thickness specified herein.

c. Fill shall not be placed on surfaces that are vegetated, muddy, frozen, or which contain frost. No frozen fill will be placed.

2. Moisture Content - The moisture content of the fill shall be reduced by aeration or increased by uniform sprinkling of water as necessary, to achieve optimum moisture content to facilitate compaction. The moisture content shall be within ± 2 percentage points of optimum. Fill shall not be placed in water.

3. Surface Drainage - The fill surface shall be sloped to facilitate the removal of runoff from the site and to prevent ponding of surface water. During periods of anticipated inclement weather, the surface of the fill shall be graded and sealed as directed by the Engineer to preclude percolation of surface water. If ponding of surface water does occur, the area shall be regraded to eliminate areas of standing water.

4. Bonding of Lifts

The Contractor shall take particular care to assure that the soil lifts are properly bonded by:

a. Making sure the surface of a previously-compacted lift is rough before placing the new lift of soil (the previously-compacted lift shall be scarified with a disc prior to placement of a new lift if the surface is not properly roughened.

b. Using a fully-penetrating footed roller.

G. Compaction of Select Material Fill.

1. Equipment - Prior to the initiation of Work, the Contractor shall submit to the Engineer for his approval, a list of the proposed compaction equipment including the Manufacturer's specifications for each proposed compactor. The use of sheepsfoot or tamping rollers shall be limited to the compaction of fine grained, plastic soils.

2. Each layer of material shall be compacted to a minimum of 95 percent of maximum dry density determined in accordance with ASTM D1557 (Modified Proctor) unless otherwise specified to meet the permeability requirement described in Section 3.06(E).

3. Sufficient passes of the equipment shall be made in order to obtain the specified densities. A minimum of four passes of the compactor is required over all portions of each lift.

4. As compaction of fill in each work area has been completed, leave the area undisturbed for a reasonable period of time for testing in accordance with Section 01400. Fill shall not be placed over a layer which has not been tested and accepted by the Engineer.

5. Unsatisfactory Compacted Fill - The contractor shall be directed by the Engineer to correct any unsatisfactory compacted materials by removal and replacement or by scarifying, aerating, or sprinkling (as needed), and recompaction and retesting, in-place prior to placement of a new lift, at the Contractor's expense.

6. Moisture content of the exposed lift shall be maintained during compaction work. Desiccation cracking shall result in removal and reinstallation of affected area by the Contractor at his own expense.

H. Preparation of Subgrade for Stage 2, Final Cover.

1. Upon verification of soil cleanup as described in Section 13210, Part 3.12, and demobilization of the SVE System as described in Section 01710, the Stage 1 cover topsoil shall be removed and temporarily stockpiled, and the subgrade shall be prepared for the Stage 2 Final Cover.

a. Stage 1 topsoil shall be stockpiled in a location approved by the Engineer.

b. The topsoil shall be sufficiently removed to expose the select material subbase. The subbase shall be scarified or tilled to a minimum depth of six inches. The subbase shall be recompacted as described in Part 3.06(g) to achieve a minimum 95 percent maximum dry density.

c. The geocomposite drainage net (Section 02282) shall be placed on the compacted subgrade after acceptance of the subgrade by the Engineer.

I. Placing Suitable Material Fill.

1. Suitable material for the Stage 2 Final cover shall be placed on the geocomposite drainage net described in Section 02282 - GEOCOMPOSITE DRAINAGE NET.

The suitable fill shall be placed in maximum 12-inch thick layers. Compaction shall be accomplished by the movement of the grading equipment.

2. SVE Equipment Demobilization.

   a. Suitable fill for the Stage 2 cover shall be placed after demobilization of the SVE equipment.

3. Placement Over Drainage Net.

   a. The Contractor shall place all cover materials located on top of geocomposite drainage nets so as to cause:

      - no damage to the geocomposite drainage net, and
      - minimal slippage of the geocomposite drainage net on underlying materials.

   b. No construction equipment shall operate on the exposed geocomposite drainage net.

   c. A minimum thickness of 1 foot of soil must be maintained between a light, low ground pressure equipment (such as a wide pad Caterpillar D-7 or lighter) and the geocomposite drainage net.

   d. A minimum thickness of 1 foot of soil must be maintained between rubber-tired vehicles and the geocomposite drainage net unless approved by the Engineer.

   e. In heavily trafficked areas such as access ramps, suitable material thickness shall be at least 3 feet.

3.07 SIDEWALL SOIL SAMPLING PROTOCOL

A. On March 4, 1997, the Trustees confirmed that if exit soil sampling shows that the sidewalls of the southern pad excavation are contaminated above Indiana Department of Environmental Management (IDEM) RCRA clean closure criteria, the Trustees will excavate such contamination to the extent practicable. If in the judgment of the Trustees, such contamination cannot be practicably excavated in its entirety, then the lateral extent of unexcavated sidewall contamination will be determined. The goal of the sidewall sampling plan is to determine the extent of contamination and to then remove all contaminated soil that exceeds RCRA clean closure criteria unless it is impracticable to do so. All efforts consistent with this sidewall sampling protocol will be made to, at a minimum, excavate all contaminated soil which is above Exhibit A, Table 3-1 cleanup standards. A summary of the criteria and procedures that will be used by the Trustees is provided below:

1. **Excavation and/or Delineation of Sidewall Contamination Implementation Summary**

   a. Ninety days prior to the commencement of excavation in the southern concrete pad area, the Trustees shall submit to EPA and IDEM a summary of the current IDEM RCRA clean closure criteria as applied to the ECC Site.

   b. Sampling and analysis by Trustees: Prior to commencement of excavation in the southern concrete pad area, either a field gas chromatograph (GC) will be set up and calibrated by a qualified operator in a dedicated trailer, or arrangements will be made with a laboratory local to the Indianapolis area for 24 hour (or better) turn around. Calibration curves will be prepared for the Volatile Organic Compounds (VOCs) in Table 3-1, with detection limits less than the corresponding IDEM RCRA clean closure. The Field GC analysis if applicable, will be conducted in accordance with EPA Method 8021 to achieve Level 3 Data Quality Objectives (DQOs). If a field GC is to be used, a supplement to the QAPP for the field GC activities will be provided no less than 60 days prior to the start of excavation of the southern concrete pad area.

   c. Sampling and analysis by U.S. EPA Side wall samples for cleanup verification will be collected by EPA at the locations specified by EPA/IDEM as described in the revised Exhibit A. The EPA, will use OVA or HNμ results to assist in identifying where to collect sidewall and floor samples. The EPA will also evaluate the use of field GC results as screening tool prior to collecting samples for cleanup verification. All confirmatory sidewall samples collected by the EPA will be sent to an offsite laboratory for analysis. The sample locations will be documented by EPA and will be provided for field GC analysis to the Trustees via a chain-of -custody sheet. If a field GC is used by the Trustees, sufficient sample will be provided to the Trustees by EPA for both the Trustees field GC analysis and any confirmatory laboratory analysis called for by the Trustees field GC QAPP supplement.

   d. The results of the sidewall sampling and analysis will be compared to the soil cleanup criteria in Table 3-1 and the RCRA clean closure criteria described in Paragraph 1.a. above.

e. In the area of the excavation where sheetpiling is not required (the western and southern portions of the excavation):

1. If visible contamination is present in the sidewalls to the west or south, or the sidewall soil sampling results from the west or south side walls exceed the Table 3-1 soil cleanup values, every reasonable effort will be made to extend the excavation to the south or west as appropriate to assure that soils that are visibly contaminated or in excess of the Table 3-1 values are excavated within the limits of safety and practicability. If those sidewall sampling results are below Table 3-1 soil cleanup values but are above the RCRA clean closure criteria referred to in Section A. above, those soils will also be excavated to the extent that it is practicable and cost effective in that the cost of such excavation exceeds the cost to extend a cap to this area. Although the final decision as to the extent of additional excavation will be made by the Trustees' Engineer in the field, he will consult with EPA and IDEM representatives before he makes the decision to close the excavation in accordance with the revised Exhibit A.

2. Once the additional excavation, if any, as described in Section 5.1 is complete, exit sampling shall be conducted. If the sidewall exit sampling data is below the RCRA clean closure criteria referred to in Section 1. above, then no further action will be conducted in that area. If sidewall exit sampling data is above these RCRA clean closure criteria, then a RCRA compliant cover (in accordance with Exhibit A) will be installed when the final cap is installed as and to the extent provided in Subsections 1.e.3 - 1.e.5 below.

3. Shortly before the installation of any final cap in the southern concrete pad area, the then current IDEM RCRA clean closure criteria will be established for this site using the then current IDEM RCRA clean- closure regulations and guidance.

4. Before installation of any final cap, the vertical and lateral extent of residual contamination above RCRA clean closure criteria that was not excavated (if any) will be determined by soil sampling. A soil sampling plan for the purpose will be submitted to EPA and IDEM for review and approval. This plan will be submitted to EPA and IDEM for review and approval at six months prior to beginning installation of RCRA cap.

5. A RCRA compliant cap will be installed over the area where the sampling conducted under Subsection 1.e.4 shows values in excess of the then current RCRA clean closure criteria. Any RCRA compliant cap that is required under this Subsection 1.e.5, will be installed to be continuous with the cap over the concrete pad area, if such a cap is required based on a comparison of the excavation bottom sampling with the then current RCRA clean closure criteria.

f. In the area of the excavation where sheetpiling is required (the eastern portion of the excavation), the sampling and capping steps specified in 1.e.2 to 1.e.5 will be followed, if sidewall exit sampling data on the eastern sidewalls is above the RCRA clean closure criteria. The sheetpiling to be used shall have ports distributed laterally and vertically to provide access for sidewall verification soil sampling.

g. The area for any additional action referred to in Paragraphs A.1.a. through A.1.f above, will in no event extend from the current southern excavation (concrete pad) area further east than the top of the bank of Unnamed Ditch, further south than the road to Northside Landfill, or further west than the western fence bordering the support zone. Under no circumstance will the excavation be extended to the north.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02205 - SHEET PILE CUTOFF WALL

(Rev. 2, 4/28/97)

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work required under this Section shall include a Contractor installed system of temporary sheet piles for the southern concrete pad soil excavation as shown on the Drawings.

B. The Contractor shall provide all supervision, labor, materials, equipment, tools, instruments, and supplies to complete the temporary sheeting system as specified herein and as modified, if needed, based on pre-construction test drilling.

C. Boring logs are included in Attachment D and boring locations are shown on the Drawings and are made available to the Contractor for his information to be used at his own risk. The Contractor is responsible for any conclusions to be drawn from the borings including the character of the materials to be encountered and the degree of difficulty to be expected in the performance of the work.

D. The Contractor shall perform pre-construction test drilling to confirm the location, and thickness, and hydrostatic pressure of the sand water-bearing zone beneath the southern concrete pad excavation area.

E. As provided below, the Contractor shall cut sampling access holes in the steel sheets and coordinate work with U.S. EPA, IDEM, and the Engineer for the purposes of sampling sidewall soils behind the installed sheet pile walls. In no event shall Contractor cut access holes in such numbers or locations as to endanger the safety of the excavation.

1.02 RELATED SECTIONS

A. Section 02200 - EARTHWORK

B. Section 02210 - CONSTRUCTION DEWATERING

C. Section 02281 - HDPE LINER

1.03 SUBMITTALS

A. The Contractors shall submit a Pre-Construction Test Drilling Plan in accordance with Section 01300 - Submittals.

The plan shall include, at a minimum, the following items:

1. Drilling locations.

2. Method of drilling and soil sampling.

3. Wellpoint construction details.

4. Wellpoint abandonment methods.

B. The Contractor shall submit a Sheet Pile Cutoff Plan in accordance with Section 01300 that includes:

1. Findings of the Pre-Construction Test Drilling, including the sand water-bearing zone depth and thickness.

2. Alignment of the sheet pile cutoff wall.

3. Description of procedures to apply waterproofing sealant to sheet interlock joints.

4. Description of equipment proposed for sheet pile driving including hammer.

5. Description of proposed sheet pile driving sequence and procedure.

6. Details of sheeting and bracing, if needed.

7. Description of method to cut sampling access holes in the sheets.

8. Description of procedure to remove and decontaminate sheets.

1.04 QUALITY ASSURANCE

A. Driving and erecting work shall be done by a Contractor who is regularly engaged in the driving and erection of steel sheeting and installation of bracing and tiebacks.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sheet piling shall be new or like-new cold-rolled XZ-85 (Minimum Section Modulus, S=30.2 in^3/ft) sheet piles conforming to ASTM Designation A328. Material is available from the following supplier:

International Construction Services
Pittsburgh, Pennsylvania
(412) 788-6430

An alternate sheet pile section may be used by the Contractor if it meets the minimum section modulus (s) and other requirements of these specifications. Alternate sheet sections shall be approved by the Engineer prior to installation.

B. Tiebacks, if used, shall be high strength steel.

C. Timber bracing and shoring, if used, shall be stamped and graded dimensional, structural grade Southern Pine or Douglas Fir.

D. Sheet pile joint sealant shall be Adeka Ultra Seal A-50 single component hydrophilic clear liquid water stop with an expansion coefficient of 5. The Adeka A-50 Sealant shall be applied for use in waterproofing sheet pile interlock joints prior to driving sheet piles.

PART 3 - EXECUTION

3.01 GENERAL

A. Any damage resulting from failure of sheeting by improper driving methods, or failure of, or inadequate shoring of temporary supports shall be corrected by the Contractor at no additional cost.

3.02 JOINT SEALANT

A. Joint sealant shall be applied to each sheet interlock prior to driving the sheets. Joint sealant shall be applied and cured in accordance with the manufacturer's and supplier's recommendations.

3.03 SHEET PILING CUTOFF WALL

A. The sheet piling wall shall be driven to a depth of 1 foot or greater beneath the bottom of the sand water-bearing zone to allow embedment into the underlying silty clay till layer to act as a hydraulic barrier wall.

B. The western sheet pile alignment shall be based on providing a minimum 4-foot thick soil cover between the bottom of the soil excavation and the top of the sand water-bearing zone. The north and south sheet pile walls shall be maintained on the alignments as shown on the Drawings. The tie-in point of these walls to the western sheet pile wall may result in an adjustment of only the wall length from the length shown on the Drawings.

C. Sheet piles shall be driven by approved methods in such a manner as not to subject the sheeting to injury and to insure interlocking throughout their length. In the event that any sheeting interlock becomes disengaged or damaged, the Contractor shall do whatever is necessary to complete the work as shown and specified without additional compensation.

D. Sheeting shall be driven or cut off so as to project at least 8 inches above the existing grade, in order to limit run-off from entering the excavation.

E. Upon completion of the work, and after backfilling with a minimum of 3 feet of select soil backfill, the Contractor shall remove the sheet piling, except as otherwise noted in these Specifications. The sheet piling must be cleaned of sealant and decontaminated prior to removal from the site, in accordance with the provisions of Section 01710. All voids caused by withdrawal of sheeting shall be immediately refilled with select soil backfill by ramming tools especially adapted to that purpose.

F. The excavation of soils immediately west of the cutoff wall shall be performed prior to removal of the sheet pile western wall so as to achieve a stable excavation slope which will not cause contaminated soil to migrate into the previous excavated area. Likewise, removal of the north sheet pile wall shall be performed to minimize contaminated soil migration into the previously excavated area.

3.04 HDPE LINER INSTALLATION INSIDE OF SHEET PILE CUTOFF WALL

A. The Contractor shall leave a sloped soil "wedge" inside of the sheet pile wall area on the northern sheet pile wall as shown on the Drawings. The soil wedge shall be the subbase for the HDPE liner section placed inside the excavation. The liner shall be installed inside of the sheet pile wall area.

B. The Contractor shall remove the sheet pile walls after placement of a minimum of 3 feet of backfill above the 9 foot cut line of the excavation. The northern wall shall be removed after placement of the HDPE liner. The Contractor shall remove the northern wall sheets in a manner so as not to damage the HDPE liner.

3.05 SAMPLE ACCESS HOLES IN SHEET PILES

A. Sidewall soil samples in the area of the sheet pile cutoff wall will be collected by U.S. EPA at locations specified by U.S. EPA/IDEM. The Contractor shall drill or bore sampling access holes in the installed sheet piles at the specified locations to the extent possible in accordance with this specification.

B. Access holes shall be drilled or bored only through the portion of the sheet piles exposed within the excavation. No holes shall be drilled or bored below the grade of the excavation bottom.

C. Access holes shall be a nominal 3 inches in diameter or less to accommodate standard soil sampling spoons. Larger holes shall be drilled or bored only if approved by the Engineer.

D. Access holes shall NOT be drilled or bored in adjoining sheets and the total surface area of the holes in a single sheet shall not exceed 10 percent of the surface area of the sheet.

E. Access hole spacing shall be a minimum 24 inches on centers or greater.

F. Access holes shall NOT be drilled or bored through a sheet joint or a bent section of the sheet.

G. Upon collection of the soil sample from behind the wall, a minimum 5-inch by 5-inch steel plate, with a thickness not less than the sheet piling, shall be centered and welded over the access hole. All welding shall conform to American Welding Society D1.1 - Structural Welding Code.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02210 - CONSTRUCTION DEWATERING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, and equipment required to remove ponded water in excavation and fill areas and all surface water and groundwater entering excavations during construction. The sources of water may include, but are not limited to the following:

1. Ponded water on the concrete pads and other site areas within the Remedial Boundary.

2. Southern concrete pad subbase water.

3. Southern concrete pad soil excavation open pumping and,

4. Sand water-bearing zone dewatering for the southern concrete pad excavation.

B. All pumped water shall be conveyed to the onsite wastewater storage system tank designed as T1.

1.02 RELATED SECTIONS

A. Section 02185 - SUMP GROUTING

B. Section 22205 - SHEET PILE CUTOFF WALL

C. Section 13050 - WASTEWATER STORAGE AND TRANSFER SYSTEMS

1.03 SUBMITTALS

A. The Contractor shall submit a Construction Dewatering Plan in accordance with the requirements of Section 01300 - SUBMITTALS.

B. Receipt by the Engineer of the Contractor's plan for dewatering shall not obligate the ECC Trust as to the efficiency of the Contractor's plan. The Contractor shall be solely responsible for the means, methods, and adequacy of the dewatering system.

1.04 REFERENCES

A. Attachments A and D of these Specifications contain a description of subsurface soils and groundwater conditions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Piping, wellpoints, pumping equipment, and all other materials required to provide dewatering shall be suitable for the intended purpose. Standby pumping units shall be maintained at the site to be used in case of failure of the normal pumping units.

PART 3 - EXECUTION

3.01 PREPARATION

A. Construct the wastewater storage and transfer systems prior to starting any dewatering operations.

B. Grout the ECC sump prior to dewatering the southern concrete pad area.

C. Install the sheet pile cutoff wall prior to dewatering the sand water-bearing zone.

3.01 GENERAL OPERATIONS

A. Ponded water on the southern concrete pad shall be dewatered prior to demolition of the pad.

B. Ponded water present in the designated fill areas in the northern part of the site shall be dewatered prior to placement of the fill.

C. Water shall be pumped from the construction areas at a sufficient rate so as not to impede construction. The dewatering equipment shall be adequately sized to remove at a minimum the normal volume of precipitation expected to occur during the time period of the construction activity.

D. All waters shall be transferred from the work areas by temporary pipeline directly into tank T1 of the wastewater storage system. The Contractor shall meter (or otherwise measure) dewatering quantities on a daily basis as they are generated.

E. Waters encountered during construction at a volume in excess of that which can be transferred into the wastewater storage system shall be temporarily stored by the Contractor by a means approved by the Engineer.

3.03 SAND WATER-BEARING ZONE

A. The sand water-bearing zone within the sheet pile cutoff wall enclosure shall be dewatered at a rate as necessary to lower the water-bearing zone hydrostatic pressure to a safe level which allows open excavation of soil within the cutoff wall area.

The estimated safe hydrostatic pressure level is four feet or greater below the finished floor of the soil excavation at any point inside of the cutoff wall. Preliminary dewatering rates range from 0.5 to 5.0 gpm.

B. Dewatering shall be continued until the excavation within the cutoff wall area is backfilled with a minimum of 3 feet of compacted select fill.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02280 - GEOTEXTILES

(Rev. 1, 2/7/97)

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes the procurement, transportation, storage, handling, seaming, and installation of the geotextile for protection of the HDPE liner and underlayment of the erosion control revetment.

1.02 RELATED SECTIONS

A. Section 01300 - SUBMITTALS.

B. Section 02281 - HIGH DENSITY POLYETHYLENE LINER.

C. Section 02750 - EROSION CONTROL REVETMENT.

1.03 REFERENCES

A. ASTM D-3776 - Test Methods for Mass Per Unit Area (Weight of Woven Fabric).

B. ASTM D-3786 - Test Method for Hydraulic Bursting Strength of Knitted Goods and Non-Woven Fabric: (Diaphragm Burst Strength Tester Method).

C. ASTM D-4355 - Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

D. ASTM D-4533 - Test Method for Trapezoid Tearing Strength of Geotextiles.

E. ASTM D-4632 - Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).

1.04 SUBMITTALS

A. The Contractor shall submit the following for the geotextile in accordance with Section 01300 - SUBMITTALS:

1. Product Data:

   a. Manufacturer's descriptive literature and specifications covering the product specified, including installation information.

2. Certificates of Conformance:

   a. Manufacturer's certification that the geotextile will be manufactured in accordance with specified reference standards.

3. Product Sample:

   a. A representative sample of the geotextile suitable for testing.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The geotextile underlying the Erosion Control Revetment and overlying the HDPE liner in the concrete pads excavation area shall be a nonwoven heat-bonded geotextile comprised of polypropylene filaments which are formed into a stable network which meets or exceeds the following minimum average roll value (MARV) properties:

Fabric Properties	Test Method	MARV
Weight, oz/yd^2 (min.)	ASTM D-3776	7.7
Grab Tensile Strength, lbs.	ASTM D-4632	200
Grab Tensile Elongation, %	ASTM D-4632	60
Trapezoidal Tear Strength, lbs.	ASTM D-4533	85
Mullen Burst Strength, psi	ASTM D-3786	250
Ultraviolet Stability, %	ASTM D-4355 (Xenon Arc) 500 hrs exposure	70

2.02 SHIPMENT AND STORAGE

A. During shipment and storage, the Contractor shall protect geotextiles from ultraviolet light exposure, precipitation, snow or other inundation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions. Geotextile rolls shall be wrapped in plastic sheets or otherwise protected. Wrappings protecting the geotextile rolls shall be removed less than 1 hour prior to unrolling the geotextile.

B. Geotextiles shall not be exposed to precipitation prior to being installed. During cold weather, geotextiles must be protected from freezing.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Geotextile procurement, transportation, storage, handling, seaming, and installation shall be the responsibility of the Contractor. Any damaged or unacceptable material shall be replaced at no additional cost to ECC. During shipping and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions. Geotextile rolls shall be shipped and stored in relatively opaque and watertight wrappings.

B. The Contractor shall handle geotextiles in such a manner as to minimize damage and shall comply with the following:

1. The nonwoven geotextile underlying the Erosion Control Revetment mat shall extend to the limits of the mat and anchor into the anchor trench with the mat. The geotextile shall be laid in the direction of the channel and shall be overlapped both side-to-side and end-to-end a minimum of 2 feet.

2. On slopes, the geotextile overlying the HDPE liner shall be securely anchored and then rolled down the slope in such a manner as to continually keep the geotextile sheet in tension.

3. Geotextile overlap seams for the geotextile overlying the HDPE liner shall lie perpendicular to the slope and the geotextiles shall be overlapped a minimum of two feet in each direction.

4. Geotextiles shall be weighted with sandbags or other approved method which will remain until replaced with cover material.

5. Necessary precautions should be taken to prevent damage to underlying layers during placement of the geotextiles.

6. Geotextiles shall not be exposed to precipitation prior to being installed, and shall not be exposed to direct sunlight for more than 15 days (unless otherwise approved by the Engineer).

7. Particular attention should be paid to overlaps to insure that no cover material is inadvertently inserted beneath the geotextile.

8. Place all cover materials in such a manner to insure that the geotextile is not damaged, there is minimal slippage of the geotextile or underlying layers, and no excess tensile stresses are present in the geotextile.

9. No construction equipment shall operate on exposed geotextiles.

3.02 REPAIRS

A. Holes or tears in the fabric shall be repaired as follows:

1. A patch with 2 feet (minimum) overlap in all directions will be placed on the tear.

2. If tear exceeds 10 percent of roll width, that roll will be replaced.

3.03 QUALITY CONTROL

A. Visual inspections of shipment and storage activities shall be made to assure that the fabric has been protected from ultraviolet light exposure, precipitation or other inundation, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02281 - HIGH DENSITY POLYETHYLENE LINER

(Rev. 1, 2/7/97)

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide all labor, materials, and equipment necessary to supply, install, field seam, and test 60-mil high density polyethylene (HDPE) within the concrete pad excavation area. All materials used shall meet the requirements of these Specifications, and all work shall be performed in accordance with the procedures provided herein and with all project lines, grades, cross sections, and dimensions shown on the Drawings.

1.02 RELATED SECTIONS

A. Section 01300 - SUBMITTALS

B. Section 02200 - EARTHWORK

C. Section 02205 - SHEET PILE CUTOFF WALL

D. Section 02280 - GEOTEXTILES

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):

1. ASTM D638 - Test Method for Tensile Properties of Plastics.
2. ASTM D746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
3. ASTM D751 - Test Method for Coated Fabrics.
4. ASTM D792 - Test Method for Specific Gravity and Density of Plastics by Displacement.
5. ASTM D1004 - Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

6. ASTM D1204 - Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.

7. ASTM D1238 - Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.

8. ASTM D1505 - Test Method for Density of Plastics by the Density-Gradient Technique.

9. ASTM D1603 - Test Method for Carbon Black in Olefin Plastics.

10. ASTM D1693 - Test Method for Environmental Stress Cracking of Ethylene Plastics.

11. ASTM D3015 - Recommended Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.

B. Federal Test Method Standards (FTMS):

1. FTMS, Number 101C, Method 2065 - Test Method for Puncture Resistance (1/8 Inch Probe).

1.04 SUBMITTALS

A. The Contractor shall submit the following under the provisions of Section 01300 - SUBMITTALS:

1. Product Data:

a. Geomembrane field panel layout plan and pipe penetration details.

b. Manufacturer's descriptive literature and specifications covering the product specified, including installation information.

2. Certificates of Conformance:

a. Manufacturer's certification that the 60-mil HDPE liner will be manufactured in accordance with specified reference standards.

3. Product Samples:

a. A representative sample of the 60-mil HDPE liner suitable for testing.

PART 2 - PRODUCTS

2.01 HDPE LINER

A. The HDPE geomembrane shall be manufactured of new, first-quality products designed and manufactured specifically for the intended purpose.

B. The HDPE liner material shall be so produced as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter.

C. The resin used in manufacturing the HDPE liner shall meet the following minimum requirements:

Property	Test Method	Unit	Value
Density	ASTM D792/D1505	g/cc	0.940
Melt Flow Index	ASTM D1238	g/10 minutes	≤0.492

D. Reclaimed polymer shall not be added to the resin.

E. The HDPE liner shall be 60-mil DURA SEAL HDPE as manufactured by the National Seal Company or Engineer approved equal. The HDPE liner shall meet or exceed the following minimum average roll value (MARV) properties:

Property	**Test Method**	**Units**	**MARV**
Thickness	ASTM D751, NSF Mod.		
Average		mils	60
Lowest Individual Reading		mils	57
Carbon Black Content	ASTM D1603	percent	2 to 3
Carbon Black Dispersion	ASTM D3015, NSF Mod.	rating	A1, A2, or B1
Tensile Properties	ASTM D638, NSF Mod.		
Strength at Yield		ppi	132
Strength at Break		ppi	228
Strain at Yield		percent	13
Strain at Break		percent	560
Tear Resistance	ASTM D1004	lbs	45
Puncture Resistance	FTMS 101C, Method 2065	lbs	78

Property	Test Method	Units	MARV
The following parameters shall be tested at the frequency the Manufacturer and Owner agree upon (not less than one sample per railcar of resin):			
Brittleness Temperature	ASTM D746 B, Pass	°F	-76 max
ESCR	ASTM D1693, NSF Mod.	hours	1,500
Dimensional Stability	ASTM D1204, NSF Mod.	percent	1.5 max

2.03 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall properly deliver, unload, and store the HDPE liner in such a manner as to prevent damage to the HDPE liner.

B. The HDPE liner material shall be protected during storage to prevent material degradation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Anchoring

1. The liner shall be anchored at the top of the slope in a trench and shall runout at the slope toe as shown on the Drawings.

2. The anchor trench shall be excavated to the lines and grades shown on the Drawings, prior to HDPE liner placement.

3. The anchor trench shall be backfilled after placement of the HDPE liner and overlying geotextile and compacted as soon as possible with hand-operated equipment.

4. Care shall be taken when backfilling the trenches to prevent any damage to the HDPE liner.

5. Slightly rounded corners will be provided in trenches where the geomembrane adjoins the trench to avoid sharp bends in the liner. Loose soil shall not underlie the geomembrane in the trenches. Seaming shall continue through the anchor trench.

B. HDPE Liner Placement:

1. Field Panel Identification:

a. Each field panel shall be given an "identification code" consistent with the layout plan. This code shall be as simple and logical as possible.

b. Seams shall be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams shall be minimized. Horizontal seams shall not be greater than 5 feet from the toe of slopes, or area of potential stress concentration, unless otherwise authorized.

2. Panel Placement:

a. Location:

(1) Field panels shall be installed at the locations indicated in the layout plan or as modified by the Engineer.

b. Installation Schedule:

(1) Field panels shall be placed one at a time, and each field panel shall be seamed immediately after its placement unless otherwise approved by the Engineer.

(2) In no event shall more panels be placed than can be seamed during the working hours of the day they are placed.

(3) Overlaps shall be shingled downslope to facilitate drainage.

3. HDPE Liner Deployment:

a. HDPE liner placement shall not proceed at a sheet temperature below 5 degrees C (40 degrees F) or above 40 degrees C (104 degrees F) for extrusion welding and 60 degrees C (140 degrees F) for fusion welding, during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds that might affect proper placement.

b. HDPE Liner placement shall follow these guidelines:

(1) Equipment used shall not damage the HDPE liner by any means.

(2) Personnel working on the HDPE liner shall not smoke, wear damaging shoes, or engage in other activities that could damage the HDPE liner.

(3) The method used to unroll the panels shall not cause scratches or crimps in the HDPE liner and shall not damage the supporting soil.

(4) The method used to place the panels shall minimize wrinkles.

(5) Sandbags shall be placed to prevent the HDPE liner from being uplifted by wind. In case of high winds, continuous loading is recommended along the edges of panels to minimize risk of wind flow under panels.

(6) The HDPE liner in high traffic areas shall be protected by geotextiles, extra HDPE liner, or other materials.

c. Seams shall be oriented longitudinally with the slopes (i.e., positioned up and down slopes).

d. The prepared surface underlying the geomembrane shall not have deteriorated since previous acceptance and still be acceptable immediately prior to geomembrane placement.

4. HDPE Liner Seaming:

a. Overlapping and temporary bonding requirements are as follows:

(1) The panels of HDPE liner shall be overlapped by a minimum of 3 inches for extrusion welding or 5 inches for fusion welding, but in any event sufficient overlap will be provided to allow peel tests to be performed on the seam.

(2) The procedure used to temporarily bond adjacent panels together shall not damage the HDPE liner; the temperature of any spot welding apparatus shall be controlled such that the HDPE liner is not damaged.

b. Seams shall be prepared in accordance with the following requirements.

(1) Prior to seaming, the seam area shall be clean and free of moisture, dust, dirt, and foreign material.

(2) If seam overlap grinding is required, the process shall be completed according to the manufacturer's instructions and in a way that does not damage the HDPE liner.

(3) The electric generator is placed on a flat smooth base and a rub sheet such that no damage occurs to the geomembrane.

(4) A smooth insulating plate or fabric is placed beneath the hot seaming apparatus after usage.

(5) A rub sheet must be used to protect the liner while cutting any materials.

(6) No abrading is visible when welding is complete.

(7) No metal objects that could potentially damage the liner are permitted for use on the lined area.

(8) No "fish mouths" shall be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, overlapped, and an overlap fusion weld shall be applied. All welds on completion of the work shall be tightly bonded. Any liner area showing injury caused by excessive scuffing, puncture, or distress for any cause shall be replaced or patched.

c. Approved processes for field seaming are extrusion welding and fusion welding. All production seams shall be fusion welded with extrusion welding only being used for detail and patch work as approved by the Engineer. Only apparatuses that have been specifically approved by the Engineer (by make and model) shall be used. Welding process requirements are as follows:

(1) Extrusion Process:

(a) The welding apparatus shall be equipped with gauges that indicate the temperature in the apparatus and at the nozzle.

(b) The Contractor shall maintain one spare operable seaming apparatus onsite.

(c) The extruder shall be purged prior to beginning a seam until all heat degraded extrudate has been removed from the barrel.

(2) Fusion Process:

(a) The fusion welding apparatuses shall be automated, vehicular-mounted devices that produce a double seam with an enclosed space.

(b) The fusion welding apparatus shall be equipped with gages that indicate its temperatures and pressures.

(c) The Contractor shall maintain one spare operable seaming apparatus onsite.

(d) A firm support directly under the seam overlap will be provided.

(e) A movable protective layer will be used directly below each overlap of HDPE liner that is to be seamed to prevent buildup of moisture between the sheets.

d. Field seaming shall be conducted within the following weather condition requirements:

(1) Unless authorized in writing by the Engineer, no seaming shall be attempted at a sheet temperature below 5 degrees C (40 degrees F) or above 40 degrees C (104 degrees F) for extrusion welding and 60 degrees C (140 degrees F) for fusion welding. The sheet temperatures shall be measured with the thermometer on the surface of the HDPE liner sheet. Alternative seaming plans (cold weather or hot weather) must

be approved by the Michigan Department of Natural Resources.

(2) The HDPE liner shall be dry and protected from wind.

e. The Contractor will retain all ownership and responsibility for the HDPE liner until accepted by the Engineer.

5. Defects and Repairs:

a. Repair Procedures:

(1) Tears or pinholes, blisters, large holes, undispersed raw materials, and contamination by foreign matter shall be repaired by patches or seaming as determined by the Engineer.

(2) Surfaces of HDPE that are to be patched shall be prepared to the manufacturer's specifications.

(3) Wrinkles at the seam overlaps will be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut wrinkles will be seamed and any portion where the overlap or round patch of the same liner extending a minimum of 6 inches beyond the cut in all directions.

(4) Patches shall be round or oval in shape, made of the same HDPE liner and extended a minimum of 6 inches beyond the edge of defect or repair.

(5) Patches shall be applied using approved seaming methods.

b. Seam Reconstruction Procedures:

(1) Seam reconstruction for the extrusion welding process shall be achieved by grinding the existing seam and rewelding a new seam.

(2) Seam reconstruction for the fusion process shall be achieved by applying a new strip of geomembrane along the length of a delineated faulty seam. The cap-strip shall extend at least 6 inches beyond the limit of the seam and the edges will be extrusion seamed to the underlying geomembrane.

c. Replacement Procedures:

(1) The faulty seam is cut out and a replacement strip is welded in its place.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02282 - GEOCOMPOSITE DRAINAGE NET

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall provide all labor, materials, and equipment necessary for the furnishing and installation of the geocomposite drainage net which consists of a heat-bonded geotextile/high density polyethylene (HDPE) drainage net composite for placement in the Stage 2 final cover as described herein. All materials used shall meet the requirements of these Specifications, and all work shall be performed in accordance with the procedures provided herein and with all project lines, grades, cross sections, and dimensions shown on the Drawings.

1.02 RELATED SECTIONS

A. Section 01300 - SUBMITTALS

B. Section 02200 - EARTHWORK

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):

1. ASTM D413 - Test Method for Rubber Property - Adhesion to Flexible Substrate.
2. ASTM D1238 - Test Method for Flow Rate of Thermoplastics by Extrusion Plastometer.
3. ASTM D1505 - Test Method for Density of Plastics by the Density-Gradient Technique.
4. ASTM D1603 - Test Method for Carbon Black in Olefin Plastics.
5. ASTM D1777 - Test Method for Measuring Thickness of Textile Materials.
6. ASTM D3776 - Test Method for Mass Unit Area (Weight of Woven Fabric).
7. ASTM D3786 - Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabric: Diaphragm Bursting Strength Tester Method.

8. ASTM D4491 - Test Methods for Water Permeability of Geotextiles by Permittivity.

9. ASTM D4533 - Test Method for Trapezoid Tearing Strength of Geotextiles.

10. ASTM D4632 - Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).

11. ASTM D4716 - Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.

12. ASTM D4751 - Test Method for Determining Apparent Opening Size of a Geotextile.

13. ASTM D4833 - Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

14. ASTM D5035 - Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Test).

15. ASTM D5199 - Test Method for Measuring Horizontal Thickness of Geotextiles and Geomembranes.

16. ASTM D5261 - Test Method for Measuring Mass Per Unit Area of Geotextiles.

1.04 SUBMITTALS

A. The Contractor shall submit the following under the provisions of Section 01300 - SUBMITTALS:

1. Product Data:

a. Manufacturer's descriptive literature and specifications covering the product specified, including installation information.

2. Certificates of Conformance:

a. Manufacturer's certification that the geocomposite drainage net will be manufactured in accordance with specified reference standards.

3. Product Sample:

   a. A representative sample of the geocomposite drainage net suitable for testing.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

   1. The geocomposite drainage net shall be manufactured by heat-bonding the geotextile to both sides of the HDPE drainage net as shown on the Drawings. No glue, adhesive, or other foreign substance shall be permitted. No product exhibiting burned through geotextiles shall be permitted.

   2. The geocomposite drainage net shall be manufactured to exhibit a bond between the HDPE drainage net and the geotextile, which shall have a minimum strength greater than or equal to 2 pounds per inch in accordance with ASTM D413.

B. Physical Properties:

   1. The geocomposite drainage net shall meet or exceed the following criteria:

      a. HDPE Drainage Net:

         (1) The HDPE drainage net shall be manufactured by extruding two sets of polyethylene strands to form a three dimensional structure to provide planet water flow. The resin shall be selected to provide an optimum combination of strength, environmental resistance, and resistance to high compressive loads that might reduce transmissivity.

         (2) The HDPE drainage net shall contain stabilizers to prevent ultraviolet light degradation.

         (3) The HDPE drainage net shall be Poly-Net 3000 as manufactured by the National Seal Company or Engineer approved equal. The HDPE drainage net shall meet or exceed the following minimum properties:

Property	Test Method	Unit	Value
Resin Density	ASTM D1505	g/cm^3	.940
Resin Melt Index	ASTM D1238	g/10 min	1.0 max.
Carbon Black Content	ASTM D1603	%	2
Thickness	ASTM D5199	inches	0.200
Mass Per Unit Area	ASTM D5261	lbs/ft^2	0.162
Transmissivity at 15,000 psf	ASTM D4716*	m^2/sec	1×10^{-3}
Tensile Strength Machine Direction	ASTM D5035	lbs/in	42

* Per ASTM D4716, the transmissivity was measured using water @ 20°C (68°F) with a gradient of one, between two steel plates, after 1 hour. Value may vary, based on dimensions of the transmissivity specimen and specific laboratory.

(4) National Seal Company
Farnsworth Center
1245 Corporate Boulevard
Suite 300
Aurora, Illinois 60504
Telephone: (800) 323-3820
(708) 898-1161

b. Geotextile Filter Fabric:

(1) The geotextile filter fabric shall be Trevira 1125 as manufactured by Hoechst Celanese or Engineer approved equal. The geotextile filter fabric heat-bonded to the HDPE drainage net shall be a nonwoven, needlepunched polyester fabric which meets or exceeds the following minimum properties:

Fabric Property	Unit	Test Method	Value
Fabric Weight	oz/yd^2	ASTM D3776	7.1
Thickness, t	mils	ASTM D1777	95
Grab Strength	lbs	ASTM D4632	210
Grab Elongation	%	ASTM D4632	60
Trapezoid Tear Strength	lbs	ASTM D4533	75
Puncture Resistance	lbs	ASTM D4833	95
Mullen Burst Strength	psi	ASTM D3786	360
Water Flow Rate	gpm/ft^2	ASTM D4491	110
Permittivity, ψ	sec^{-1}	ASTM D4491	1.47
Permeability, $k = \psi t$	cm/sec	ASTM D4491	0.35
Apparent Opening Size (AOS)	sieve size mm	ASTM D4751	70 0.210

(2) Hoechst Celanese Corporation
P.O. Box 5887
Spartanburg, South Carolina 29304-5887
Telephone: (800) 845-7597
(803) 579-5007

2.02 SHIPMENT AND STORAGE

A. During shipment and storage, the Contractor shall protect the geocomposite drainage net from ultraviolet light exposure, precipitation, snow or other inundation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions. Rolls shall be wrapped in plastic sheets or otherwise protected. Wrappings protecting the rolls shall be removed less than 1 hour prior to unrolling the geocomposite drainage net.

B. The geocomposite drainage net shall not be exposed to precipitation prior to being installed. During cold weather, geocomposite drainage nets must be protected from freezing.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Subgrade Preparation:

1. Installation of the geocomposite drainage net shall not begin until a proper subgrade has been prepared as indicated in Section 02200 - EARTHWORK and approved by the Engineer. The prepared surface shall be free from loose earth, exposed rocks larger than 1/2 inch in diameter, rubble, and other foreign matter.

2. The surface upon which the geocomposite drainage net is to be placed shall be free of standing water and maintained in a firm, clean, and smooth condition during installation.

B. Geocomposite Drainage Net Handling and Placement:

1. The Contractor shall keep the geocomposite drainage net clean and free of debris prior to installation. If the geocomposite drainage net is not free of soil and debris before installation, it shall be cleaned by the Contractor just prior to installation. During placement, the Contractor shall take care not to entrap dirt or excessive dust into the geocomposite drainage net that could cause clogging of the drainage system, and/or stones that could damage adjacent materials.

2. On slopes, the geocomposite drainage net shall be anchored into the trench as shown on the Drawings.

3. The Contractor shall handle all geocomposite drainage net rolls in a manner which will ensure against damage in any form, and the following shall be complied with:

   a. The geocomposite drainage net shall be placed as shown on the Drawings.

   b. On slopes, the geocomposite drainage net shall be secured in the anchor trench, and then rolled down the slope in such a manner as to continually keep the geocomposite drainage net in tension. If necessary, the geocomposite drainage net shall be positioned by hand after being unrolled to minimize wrinkles.

c. The geocomposite drainage net shall not be placed across the slope (in the horizontal direction), unless otherwise approved by the Engineer.

d. In the presence of wind, all geocomposite drainage nets in place shall be weighted with sandbags filled with fine grained material or the equivalent.

e. Geocomposite drainage nets shall be cut using a hook blade or other tool approved by the Engineer.

f. A visual examination of the geotextile component of the geocomposite drainage net shall be carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects are present.

C. Seams and Overlaps:

1. Adjacent rolls shall be overlapped at least 6 inches with the geotextile overlap at least 3 inches and butt ends shall be overlapped at least 2 feet. These overlaps shall be secured by plastic ties approximately every 5 feet along the roll length, every 6 inches in the anchor trench, and every 6 inches along end-to-end seams. Plastic ties shall be white or other bright color for easy inspection. Metallic ties shall not be allowed. If self-locking plastic tie wraps are used, the locking joint shall be set within the rib to prevent damage to adjacent materials. After securing the drainage net, the geotextile shall then be continuously sewn as per the manufacturer's recommendations.

2. No horizontal seams shall be allowed on side slopes (i.e., seams shall be along, not across the slope), except as part of a patch or unless otherwise approved by the Engineer.

D. Defects and Repairs:

1. Any hole or tear in the geocomposite drainage net shall be repaired by placing a patch extending 2 feet beyond the edges of the hole or tear. The patch shall be secured to the original geocomposite drainage net by tying the drainage net every 6 inches and sewing the geotextile all around, unless otherwise approved by the Engineer. If the hole or tear width across the roll is more than 50 percent of the width of the roll, the damaged area shall be cut out and the two portions of the geocomposite drainage net shall be joined as indicated in Section 3.01.C.

E. Placement of Cover Material:

1. The Contractor shall place all cover materials located on top of geocomposite drainage net as described in Section 02200 - EARTHWORK.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02283 - TEMPORARY COVERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials and equipment required to provide temporary daily covers for contaminated soil and crushed product fill in the northern SVE treatment area. The covers are intended to prevent rainfall contact with the fill and minimize releases of vapors and particulates to the ambient air.

B. The temporary covers shall not be necessary once the Stage 1 soil cover has been placed on the fill. Temporary covers shall be demobilized by the Contractor and managed in accordance with Section 02080 - REMEDIAL ACTION GENERATED WASTES.

1.02 SUBMITTAL

A. The Contractor shall supply the Engineer with product samples and manufacturer's certifications under the provisions of Section 01300 - SUBMITTALS.

PART 2 - PRODUCTS

1.01 COVER MATERIAL

A. The temporary cover material shall be durable, puncture-resistance, and UV stabilized synthetic membrane capable of being easily placed and removed on a daily basis over the contaminated fill area. The temporary cover shall be black Permalon X-150 or equivalent as manufactured by:

Permalon
Reef Industries, Inc.
P.O. Box 750245
Houston, Texas 77275-0245
(713) 484-6892

The temporary cover material shall have the following properties:

Physical Properties			
Property	ASTM Method	Units	Value
Thickness	D-2103	mils	8.6
Standard Weight	D-2103	lb/1000 sq. ft.	30.4
Tensile - MD	D-882	lbf psi	36.3 4244
Tensile - MD	D-882	lbf psi	32.2 3774
Elongation - MD	D-882	%	757
Elongation - TD	D-882	%	491
Tongue Tear - MD	D-1938	lbf	4.7
Tongue Tear - TD	D-1938	lbf	4.4
PPT Tear - MD	D-2582	lbf	18.0
PPT Tear - TD	D-2582	lbf	18.3
Shrinkage - Area	D-1204	%	2.2
Drop Dart	D-1709	g	618
Cold Crack	D-1709 mod.	°F	-60

PART 3 - EXECUTION

3.01 Temporary covers shall be fabricated in sections that will enable coverage of the entire width of the fill area. Nominal size of each section is 100 x 300 feet. Individual sections shall be overlapped to allow coverage of the entire fill area not covered with Stage 1 cover soil. Horizontal seams shall be used in such a manner that the downslope sheet is overlapped by the upslope sheet by a minimum of 24 inches.

3.02 The temporary cover system must be maintained securely in place with a system of anchor trenches, or tires and sandbags. Anchoring trenches 8" wide and 12" deep shall be placed at the bottom of the slope slightly outside the perimeter of the fill area. Excess cover material (approximately 1-foot on each side) should be placed in the trench before backfilling into the trench. In all cases, site conditions (wind, degree of slope) should be considered when placing the temporary cover system. Any defects, rips, tears or punctures found during or immediately after the installation should be repaired.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02550 - MONITORING WELLS

PART 1 - GENERAL

1.01 SUMMARY

A. The work covered under this section consists of furnishing all labor, equipment, and material necessary to drill and install the compliance monitoring wells and retrofit existing wells with new protective casings.

B. The Contractor shall possess all necessary licenses and shall obtain the appropriate permits needed to comply with the State of Indiana regulations.

1.02 SITE CONDITIONS

A. Drilling Locations: Compliance monitoring well drilling locations and existing wells are shown on the Drawings.

B. Subsurface conditions are described in Attachments A and D to the Specifications.

1.03 DESCRIPTION OF WORK

A. Compliance monitoring wells shall be constructed in two water-bearing zones: the shallow till and the underlying sand, which is under pressure in some parts of the site. Compliance monitoring well construction details are provided on the Drawings.

B. Access to the drilling locations requires the use of all-terrain or tracked vehicles. The Contractor is responsible for providing all equipment necessary to gain access to the drilling locations.

C. Power generation is the responsibility of the Contractor.

D. Water shall not be provided onsite. The Contractor is responsible for providing all equipment necessary for temporary storage and transportation of water.

E. The Contractor is responsible for providing personal protective equipment (PPE). Drilling is anticipated to be completed in Level D protection. Provisions are to be made to upgrade to higher levels of protection as determined by the Health and Safety Site Officer.

1.04 RELATED SECTIONS

A. Section 02080 - REMEDIAL ACTION GENERATED WASTES.

1.05 SUBMITTALS

A. Drilling equipment and method.

B. Well materials product data.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Protective casing: 4-inch (nominal) diameter Schedule 40 low carbon steel conforming to the requirements of ASTM A333.

B. Temporary Casing: 8-inch (nominal) diameter, carbon steel.

C. Polyvinyl Chloride (PVC), Schedule 40, flush-threaded well pipe, 2-inch diameter.

D. PVC, Schedule 40 slotted well screen, 0.01 slot for till, 0.02 slot for sand, 2-inch diameter.

E. Sandpack: Morrie No. 0 sandpack (shallow till monitoring wells), Morrie No. 1 sandpack (sand zone monitoring wells).

F. Bentonite: Bentonite pellets will be used for the annular seal. Approved proportions of powdered bentonite will be used in temporary casing seals, drilling mud and annular grout.

G. Grout: Annular grout will consist of the following proportions: 94 pounds of Portland cement to 3 to 5 pounds of bentonite to 6.5 gallons of clean potable water.

PART 3 - EXECUTION

3.01 GENERAL

A. Decontamination:

1. Decontamination of equipment will be accomplished using high pressure hot water or steam at the designated onsite decontamination pad.

2. The rig and associated equipment is to be decontaminated upon arrival at departure from the site. Decontamination of downhole drilling equipment will take place between borehole locations and between till and sand zone drilling activities.

3. The Contractor is responsible for insuring the decontamination and integrity of monitoring well materials.

B. Sampling:

1. Confirmatory split spoon samples will be taken according to ASTM D-1586.

2. Sampling frequency will be continuous throughout each borehole location.

3. Appropriate sample jars are to be provided by the Contractor.

C. Waste Handling:

1. Containerization and handling of solid and liquid wastes produced during drilling and development activities are the responsibility of the Contractor. Wastes shall be managed as describe in Section 02080 - REMEDIAL ACTION GENERATED WASTES.

2. Solid wastes shall be placed in DOT 17H 55-gallon drums and stored in the Support Zone as directed by the Engineer.

3. Liquid wastes shall be placed in DOT 17H 55 gallon drums and transferred by the Contractor to the wastewater storage tank(s) in the Support Zone.

D. Development:

1. The sand monitoring wells are to be developed using the surge and pump method.

2. The till monitoring wells are to be developed by bailing.

3. Development of each well will continue for a minimum 1-hour period or until groundwater temperature, pH, and specific conductance values equilibrate.

4. In the event that monitoring wells are bailed or pumped dry before the one-hour minimum development period, the well will be permitted to recover to within 75% of the original static water level before development resumes. Development will be terminated after pH and specific conductivity equilibrate.

3.02 SHALLOW COMPLIANCE MONITORING WELL INSTALLATION

A. Pilot Testing Borings:

1. Pilot testing borings will be advanced at each shallow till compliance monitoring well location. The purpose of the test boring is to accurately define the location of the top of the sand water bearing zone and to accurately determine the placement of compliance monitoring well screens above the sand water bearing zone. Pilot test borings will not be required for compliance monitoring wells clustered with sand water bearing zone monitoring wells.

2. Pilot test borings will be advanced via the hollow-stem auger drilling method with continuous split-barrel sampling according to ASTM-D1586. Sampling will terminate when the top of the sand water bearing zone is encountered.

3. Pilot test borings will be abandoned by tremie grouting the borehole with bentonite-cement grout from the bottom to the top while incrementally removing augers from the borehole.

4. Subsequent drilling locations for compliance monitoring wells will be at offsets of approximately 15 feet in a direction specified by oversight personnel.

B. Drilling Method:

1. Off-site monitoring wells screened in the shallow till zone shall be drilled using the hollow stem auger method. A minimum 6.25-inch inside diameter (ID) hollow stem auger equipped with a pullout plug will be utilized. The borehole will be advanced to a depth that has been determined by the pilot test boring.

2. On-site monitoring wells screened in the shallow till zone will be drilled using water rotary or hollow-stem auger methods, or any drilling combination thereof. An 8- to 10-inch diameter casing will be installed through contaminated soils into the top of the glacial till. The remaining borehole will be advanced to a depth that has been determined by the pilot test boring.

C. Well Installation:

1. Off-site shallow till monitoring well construction is indicated on the Drawings. Monitoring well riser pipe and screen shall be decontaminated prior to installation unless environmentally sealed prior to installation. Measures are to be taken to avoid cross contamination of the well screen and

riser from contact with the ground, the rig, or other objects. Clean gloves are to be worn when handling the screen and riser.

2. On-site shallow till monitoring well construction is indicated on the Drawings. Monitoring well riser pipe and screens shall be decontaminated prior to installation unless environmentally sealed prior to installation. Measures are to be taken to avoid cross contamination of the well screen and riser from contact with the ground, the rig, or other objects. Clean gloves are to be worn when handling the screen and riser.

D. Annular Material Installation:

1. Annular materials (sand pack and grout) are to be emplaced through the hollow stem augers or through steel surface casings using minimum 1-inch diameter tremie pipes as the augers are simultaneously extracted from the borehole. The cement-bentonite grout slurry is to be mixed at the surface prior to emplacement and tremied into the remaining annual space.

2. The bentonite pellet seal will be installed by dropping the pellets through the hollow-stem augers or through steel surface casings to the top of the sand pack. The bentonite pellet seal will be a minimum of 1-foot thick. The bentonite pellet seal will be permitted to hydrate for at least 1 hour before backfilling the remaining annular space with cement-bentonite grout.

E. Protective Casing Installation:

1. The 4-inch steel protective casing is to be installed to a minimum 2 foot below ground surface. The casing at each location is to extend above ground surface and shall be finished with a locking cover and concrete pad as specified on the Drawings.

3.03 SAND ZONE COMPLIANCE MONITORING WELL INSTALLATION

A. Drilling Method:

1. Sand water-bearing zone monitoring wells shall be drilled using the Water Rotary Drilling Method. A 12-inch diameter wing bit or blade bit circulating water shall advance the borehole. Continuous soil samples shall be collected through the drill stem and bit. A temporary 8-inch inside diameter steel casing shall be set near the base of the till and sealed with a bentonite slurry to prevent shallow till zone cross-contamination of the sand zone. A 7⅞-inch diameter blade or wing bit will be utilized to advance the borehole into the sand zone.

B. Well Installation:

1. Sand zone monitoring well construction is indicated on the Drawings. Each well is to be installed through the steel surface casing in the open borehole. Well pipe and screens shall be decontaminated prior to installation unless environmentally sealed prior to installation. Measures are to be taken to avoid a cross contamination of the well screen and riser from contact with the ground, the rig, and other objects. Clean gloves are to be worn when handling the screen and riser.

2. After installation of the monitoring well, gravel pack and bentonite seal, the temporary casing will be removed from the borehole. The remaining annular space will be backfilled with a bentonite cement mixture via tremie pipe.

C. Annular Material Installation:

1. Annular materials (sand pack, , and grout) are to be emplaced using a tremie pipe. The cement-bentonite grout slurry is to be mixed at the surface prior to emplacement.

2. The bentonite pellet seal will be installed by dropping the pellets through the temporary casing to the top of the sand pack. The casing will be pulled from the borehole incrementally until the bentonite pellet seal is a minimum of 2-feet above the till sand zone interface. The bentonite pellet seal will be permitted to hydrate for a minimum of 1-hour before backfilling the remaining annular space with cement bentonite grout.

D. Protective Casing Installation:

1. The 4-inch steel casing is to be extended above ground surface and shall be finished with a cover and concrete pad as specified on the Drawings.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02700 - EROSION CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

A. This item includes erosion and sediment control products and measures to be used during construction activities. The purpose is to ensure that construction activities will not adversely affect adjacent properties or water resources.

1.02 REFERENCES

A. ASTM D3786 - Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method.

B. ASTM D4632 - Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).

C. ASTM D4751 - Test Method for Determining Apparent Opening Size of a Geotextile.

D. ASTM D4833 - Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

E. ASTM G26 - Practice for Operating Light Exposure Apparatus (Xenon Arc Type) With and Without Water for Exposure of Non-Metallic Materials.

F. Indiana Department of Highways, Standard Specifications, 1988.

1.03 SUBMITTALS

A. Site Fence Fabric Manufacturer's Product Data:

1. Manufacturer's published detail drawings, modified to suit design conditions if required, and Contractor prepared drawings as applicable.

2. Manufacturer's descriptive literature and specifications covering the product specified. Include installation information.

B. Silt Fence Fabric Certificates of Conformance:

1. Manufacturer's certification that components and products will be manufactured in accordance with specified reference standards for components and products.

PART 2- PRODUCTS

2.01 SILT FENCE

A. Silt Fence Fabric shall meet or exceed the following minimum specifications:

Fabric Properties	Minimum Acceptable Value	Test Method
Grab Tensile Strength (lbs)	90	ASTM D4632
Elongation at Failure (%)	50	ASTM D4632
Mullen Burst Strength (psi)	190	ASTM D3786
Puncture Strength (lbs)	40	ASTM D4833
Apparent Opening Size (AOS)	40 - 80	ASTM D4751
Ultraviolet Radiation Stability (%)	90	ASTM G-26

B. Fence Posts (for fabricated units): The length shall be a minimum of 36 inches long. Wood posts will be of sound quality hardwood.

C. Prefabricated Units: Envirofence or equal may be used in lieu of the above method providing the unit is installed per manufacturer's instructions.

2.02 VEGETATION

A. Seeding, Fertilizer, and Mulch:

1. Seeding, fertilizer, and mulch shall be as specified in Section 02710 - VEGETATION.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall plan and execute construction by methods which will minimize and control surface drainage so as to reduce erosion and sedimentation to least practicable amounts. To accomplish this objective, the following measures shall be utilized as appropriate:

1. Expose the least possible amount of bare soils at any one time.

2. Use selective placement of fill during construction to avoid entrapment of ponds of rainwater and excessive erosion.

3. Make daily inspections for erosion and sedimentation, and take corrective actions as necessary.

3.02 SILT FENCE

A. Silt fence fabric shall be placed on the top of the banks of regraded or disturbed ditches at the toe of all graded slopes, and on the downslope ends of all access or temporary haul roads outside of the support zone.

B. Inspect all slopes and drainage ditches to insure that the topsoil is well graded and free of large stones or other debris that would prevent the fabric from conforming closely to the soil.

C. Fabric shall be installed immediately after seeding operations have been completed in work areas.

D. Fabric shall be applied in accordance with the manufacturer's recommendations.

3.03 MAINTENANCE

A. The Contractor shall inspect each of the following erosion control structures and their components periodically during construction to ensure that they are in good operating condition:

1. The Contractor shall verify that the silt fence is functioning properly and in operating condition.

2. The Contractor shall verify that the riprap is in place to the required extent and thickness.

B. The Contractor shall be responsible for maintenance repairs as needed at no additional cost to the ECC Trust. Long-term maintenance is described in Section 13210 - SITE OPERATIONS AND MAINTENANCE.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02710 - VEGETATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Seeding, mulching, and fertilizer.

B. Maintenance.

1.02 REFERENCES

A. FS 0-F-242 - Federal Specifications for Fertilizers, Mixed, Commercial.

B. Indiana Department of Highways (IDOH) Standard Specifications, 1988.

1.03 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.04 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 - PRODUCTS

2.01 SEED SUPPLIERS

A. Indiana Seed Co. or others as approved by the Engineer.

2.02 SEED MIXTURE

A. Seed Mixture: Indiana Seed Company Number Six Rough Mix

1. Kentucky Blue Grass: 10 percent.

2. Perennial Rye: 25 percent.

3. Tall Fescue Grass: 65 percent.

2.03 SOIL MATERIALS

A. Topsoil, as described in Section 02200 - EARTHWORK.

2.04 ACCESSORIES

A. Mulching Material:

1. Mulch for seeded areas with finished slopes flatter than three horizontal to one vertical shall be in accordance with IDOH 913.05(a).

2. Mulch for seeded areas with finished slopes of 3 horizontal to 1 vertical or steeper shall be in accordance with IDOH 913.05(c), (d), or (e).

B. Fertilizer: FS O-F-241, Type I, Grade A; recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated in analysis to the following proportions: Nitrogen - 12 percent, phosphoric acid - 12 percent, soluble potash - 12 percent.

C. Water: Clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

D. Stakes: Softwood lumber, chisel pointed.

E. String: Organic fiber.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that prepared soil base is ready to receive the work of this section.

3.02 FERTILIZING

A. Applying fertilizer in accordance with manufacturer's instructions, at a rate of 23 pounds per 1,000 square feet.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix thoroughly into 2 inches (50 mm) of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.03 SEEDING

A. Apply seed at a rate of 4 pounds per 1,000 square feet evenly in two intersecting directions. Rake in lightly.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Planting Season: March 1 through October 15.

D. Do not sow immediately following rain, when ground is too dry, or during high wind periods.

E. Roll seeded area with roller not exceeding 112 pounds (50 Kg).

F. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches (3 mm). Maintain clear of shrubs and trees.

G. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches (100 mm) of soil.

3.04 SEED PROTECTION

A. Identify seeded areas with stakes and string around area periphery. Set string height to 6 inches.

3.05 MAINTENANCE

A. Water to prevent grass and soil from drying out.

B. Immediately reseed areas which show bare spots and water to prevent washing of slopes or dislodgement of seed.

C. Fertilize seeded area at a rate of 10 pounds per 1,000 square feet immediately following the first mowing.

D. The Contractor is not required to provide a warranty period for the vegetation.

E. The Contractor shall be responsible for maintenance repairs as needed at no additional cost to the ECC Trust. Long-term maintenance is described in Section 13210 - SITE OPERATIONS AND MAINTENANCE.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02750 - EROSION CONTROL REVETMENT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to install erosion control revetment material such as Fabriform Filter Point or approved equal, in the diversion channels as shown on the Drawings and specified herein.

1.02 RELATED SECTIONS

A. Section 01300 - SUBMITTALS.

B. Section 02280 - GEOTEXTILES.

1.03 REFERENCES

A. ASTM C-31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.

B. ASTM C-39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

1.04 SUBMITTALS

A. The Contractor shall submit the following under the provisions of Section 01300 - SUBMITTALS:

1. Product Data: Submit manufacturer's technical product data and installation instructions for Erosion Control Revetment.

2. Certificates of Conformance: Certificates of conformance for all materials shall be submitted assuring conformance with these Specifications.

PART 2 - PRODUCTS

2.01 FABRIC DESIGN

A. Fabric-forming material shall consist of double-layer, open-salvage fabric joined in a mat configuration. Fabric shall be woven of 100 percent continuous multifilament nylon fiber of which at least 50 percent by weight shall be bulk textured fiber. Staple yarns shall not be allowed.

B. Filter Point fabric, designated as Erosion Control Revetment on the Drawings, shall be woven in such a manner as to provide interwoven points of attachment on spaced centers. These points of attachment shall serve to control the thickness of the finished revetment and also act as Filter Points to provide relief of hydrostatic uplift beneath the completed revetment. They shall be woven in a basket or other open pattern to provide improved permeability.

C. Thickness of the finished revetment shall be measured as described in Part 3 of this Section.

D. The Erosion Control Revetment shall have Filter Points on 5-inch centers (Designation Style 5-Inch FP) with an average thickness of 2.2 inches and the Fiber and Fabric properties shall meet all manufacturer's specifications.

2.02 FABRIC POROSITY

A. Fabric porosity is essential for the successful execution of this work. The Contractor shall demonstrate the suitability of fabric design by injecting the proposed grout into 5 1/2-inch (140 mm) diameter sleeves. The sleeves shall be constructed of a single layer of the same basic fabric material. Test cylinders, 12 inches (300 mm) long, shall be cut from each specimen and tested in accordance with ASTM C-39.

2.03 FABRIC ASSEMBLY

A. Adjacent fabric panels shall be connected by sewing or by means of zippers. The two top layers of fabric and the two bottom layers of fabric shall be joined separately permitting full mat thickness between the two parallel seams. A single seam in which all four layers of fabric are joined at one point will not be permitted. If required, grout stops may be installed parallel to and in between individual mill widths at pre-determined intervals to regulate the flow of fluid grout. Grout stops shall be so designed as to produce full mat thickness along the full length of the grout stop.

2.04 GROUT

A. Grout shall consist of a mixture of Portland cement, fine aggregate, and water so proportioned and mixed as to provide a readily pumpable slurry. Admixtures and/or a pozzolan may be used with the approval of the Engineer. The hardened grout shall exhibit a compressive strength of 2,000 psi (14 MPa) at 28 days when specimens are made and tested according to the provisions of ASTM C-31 and C-39.

B. The average compressive strength of Fabriform cast test cylinders, as described in Paragraph 2.02.A above, shall be at least 20 percent higher at 7 days than that of companion test cylinders made in accordance with ASTM C-31, and not less than 2,500 psi (17 MPa) at 28 days.

2.05 GEOTEXTILE

A. The geotextile underlying the Fabriform mat shall be a nonwoven geotextile as specified in Section 02280 - GEOTEXTILES.

PART 3 - EXECUTION

3.01 GENERAL

A. Erosion Control Revetment shall be placed at the locations indicated on the Contract Drawings and specified herein. The revetment shall line the upgraded Parcel 45 diversion channel, channels F, H, and K, and approximately 15 feet (minimum) of channel at the inlet and outlet of each culvert.

3.02 FABRIC STORAGE

A. Immediately following receipt of fabric on the job site, fabric shall be inspected and stored in a clean dry area where it will not be subject to mechanical damage or exposure to moisture or direct sunlight.

3.03 SUBGRADE PREPARATION

A. Revetment shall be placed over relatively smooth surfaces. If backfilling is necessary, compacted sand shall be placed as indicated in the Drawings to create a relatively smooth surface.

3.04 GEOTEXTILE PLACEMENT

A. The geotextile underlying the Erosion Control Revetment shall extend to the limits of the Erosion Control Revetment and shall be anchored with the Erosion Control Revetment as specified by the manufacturer.

B. The geotextile shall be laid in the direction of the channel. Fabric panels should be overlapped both side-to-side and end-to-end a minimum of 2 feet.

3.05 FABRIC PLACEMENT

A. Prior to grout injection, the dual-walled fabric shall be positioned over the nonwoven geotextile fabric, making appropriate allowance for contraction of the fabric which will occur as a result of grout injection.

B. Panels of fabric may be factory assembled in predetermined sizes and joined together side-by-side at the job site by field sewing or by means of zipper closures attached to the upper and lower layers of fabric. If joining of panels, as described above, is impractical, adjacent panels may be overlapped a minimum of 2 feet, subject to the Engineer's approval. In no case will simple butt joints between panels be allowed.

C. The fabric shall be cut and formed around the inlet and outlet of the culvert pipes and sewn as per the manufacturer's recommendations.

D. The Erosion Control Revetment shall be anchored as per the manufacturer's recommendations. The Erosion Control Revetment shall extend vertically a minimum of 1 foot above the top of the culvert pipe.

3.06 GROUT INJECTION

A. Following placement of dual-walled fabric over the nonwoven geotextile fabric, grout shall be injected between the top and bottom layers of fabric through small slits cut in the upper layer of fabric. The injection pipe shall be wrapped tightly at the point of injection with a strip of burlap and the burlap pushed into the slit as the injection pipe is withdrawn in order to minimize spillage of grout on the surface of the revetment. The sequence of grout injection shall be such as to insure complete filling of the revetment-forming fabric to the thickness specified by the fabric manufacturer.

B. Foot traffic will not be permitted on the freshly pumped mat when such traffic will cause permanent indentations in the mat surface. Walk boards shall be used where necessary. Excessive grout which has been inadvertently spilled on the mat surface shall be cleaned up with a broom and shovel. Use of a water hose to remove spilled grout from the surface of a freshly pumped mat will not be permitted.

C. During grout injection, the mat thickness may be measured by inserting a short piece of stiff wire through the crowns of the mat midway between Filter Points at several locations from the crest to the toe of the slope. Any mat measuring less than 90 percent of the average of all thickness measurements shall be reinjected with grout until average thickness has been attained.

3.07 FIELD TESTS

A. Sets of three field control cylinder specimens shall be taken by the Contractor during the progress of the work, in conformity with ASTM C-31. The total number of specimens taken shall not be less than one set of specimens on any 1 day when concrete is placed.

B. The cylinder specimens shall be tested in accordance with ASTM C-39. The resulting compressive strengths shall be in accordance with Paragraph 2.04 of this Section.

END OF SECTION

DIVISION 2 - SITE WORK

SECTION 02900 - OFFSITE TRANSPORTATION AND DISPOSAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes the requirements for Offsite Transportation and Disposal associated with mobilization, construction and operations activities. The appropriate transportation and disposal method shall be based on the characterization of the waste types described in the related sections.

B. The Contractor shall obtain and pay for all transportation-related liability insurance, and all Federal, state, and local permits and licenses required.

1.02 RELATED SECTIONS

A. Section 01501 - DECONTAMINATION PAD

B. Section 01502 - WASTEWATER STORAGE PAD

C. Section 01710 - DEMOBILIZATION

D. Section 02080 - REMEDIAL ACTION GENERATED WASTES

E. Section 02283 - TEMPORARY COVERS

F. Section 13050 - WASTEWATER STORAGE AND TRANSFER SYSTEM

1.03 OFFSITE DISPOSAL FACILITIES

A. Solid Hazardous Waste Disposal Facilities:

1. All solid hazardous waste shall be disposed of at a RCRA permitted disposal facility in the United States. The Contractor shall select two RCRA permitted facilities which it intends to use for the transportation to and disposal of solid hazardous waste from this Site. The Contractor shall cite which of the facilities will be the primary facility and which will be the secondary facility.

2. All of the solid hazardous waste disposed from this Site will be transported to and disposed of in the primary solid hazardous waste disposal facility unless that facility becomes "out of compliance" with present RCRA

requirements. In this event, the Contractor shall transport the waste to the secondary disposal facility for disposal.

3. If the primary facility becomes compliant during the course of the transportation and disposal to the secondary disposal facility, the Contractor shall redirect the waste to the primary disposal facility.

4. The Contractor may use the following RCRA permitted solid hazardous waste disposal facility or the Contractor may select its own disposal facility meeting the requirements of these specifications and approval of the Engineer.

   a. Chemical Waste Management, Inc.
      Adams Center Facility
      Fort Wayne, Indiana

5. The Contractor shall ensure that all wastes are properly manifested for transportation and disposal and comply with all Federal and state laws and regulations concerning waste transportation and disposal. The ECC Trust shall be responsible for obtaining the generator identification number from U.S. EPA prior to offsite shipment.

B. Solid Nonhazardous Waste Disposal Facilities:

1. All solid nonhazardous waste shall be disposed of at an approved IDEM permitted municipal solid waste landfill in the United States. The Contractor shall select two approved landfills which it intends to use for the transportation and disposal of solid nonhazardous waste from this Site. The Contractor shall cite which of the landfills will be the primary landfill and which will be the secondary landfill.

2. All of the solid nonhazardous waste disposed from this Site will be transported to and disposed of in the primary landfill unless that facility becomes "out of compliance" with present requirements. In this event, the Contractor shall transport the waste to the secondary landfill.

3. If the primary landfill becomes compliant during the course of the transportation and disposal to the secondary landfill, the Contractor shall redirect the waste to the primary landfill.

4. The Contractor may use the following approved IDEM permitted municipal solid waste landfill or the Contractor may select its own landfill meeting the requirements of these specifications and approval of the Engineer.

a. Waste Management, Inc.
Danville Recycle and Disposal Facility
Danville, Indiana

5. The Contractor shall ensure that all wastes are properly manifested for transportation and disposal and comply with all Federal and state laws and regulations concerning waste transportation and disposal.

C. Liquid Hazardous Waste Disposal Facilities:

1. In the unlikely event that any liquid hazardous waste is generated, it shall be disposed of at a RCRA permitted disposal facility in the United States. The Contractor shall select two RCRA permitted facilities which it intends to use for the transportation to and disposal of liquid hazardous waste from this Site. The Contractor shall cite which of the facilities will be the primary facility and which will be the secondary facility.

2. Any liquid hazardous waste disposed from this Site will be transported to and disposed of in the primary liquid hazardous waste disposal facility unless that facility becomes "out of compliance" with present RCRA requirements. In this event, the Contractor shall transport the waste to the secondary disposal facility for disposal.

3. If the primary facility becomes compliant during the course of the transportation and disposal to the secondary disposal facility, the Contractor shall redirect the waste to the primary disposal facility.

4. The Contractor may use the following RCRA permitted liquid hazardous waste disposal facilities or the Contractor may select its own disposal facility meeting the requirements of these specifications and approval of the Engineer.

a. Heritage Environmental Services, Inc.
7901 West Morris Street
Indianapolis, Indiana 46231

b. Clean Harbors
Chicago, Illinois

5. The Contractor shall ensure that all wastes are properly manifested for transportation and disposal and comply with all Federal and state laws and regulations concerning waste transportation and disposal. The ECC Trust shall be responsible for obtaining the generator identification number from U.S. EPA prior to offsite shipment.

D. Scrap/Salvage Disposal Facilities:

1. All material certified clean including tanks and metallic structural material shall be disposed of at a scrap/salvage disposal facility in the United States. The Contractor shall select two facilities which he intends to use for the transportation to and disposal of certified clean material. The Contractor shall cite which of the facilities will be the primary facility and which will be the secondary facility.

2. All of the certified clean material disposed from this Site will be transported to and disposed of in the primary scrap/salvage disposal facility unless that facility becomes "out of compliance" with present requirements. In this event, the Contractor shall transport the waste to the secondary disposal facility for disposal.

3. If the primary facility becomes compliant during the course of the transportation and disposal to the secondary disposal facility, the Contractor shall redirect the waste to the primary disposal facility.

4. The Contractor may use the following approved scrap/salvage disposal facilities or the Contractor may select his own scrap/salvage disposal facilities meeting the requirements of these Specifications and approval of the Engineer.

   a. Oscar Winsky Company, Lafayette, Indiana.

   b. Lusco Corporation, Indianapolis, Indiana.

5. The Contractor shall ensure that all material certified clean is properly manifested for transportation and disposal and complies with all Federal and State laws and regulations concerning transportation and disposal.

1.04 SUBMITTALS

A. Copies of certificates of required insurance, permits, and licenses.

B. During the course of the Contract, the Contractor shall submit as documentation for each payment the following:

1. Copies of weigh-in/weigh-out tickets, with driver name, truck identification, date and time of day.

2. Copies of manifests.

C. Waste analyses results and waste profile sheet.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.01 DRIVER TRAINING

A. The Contractor shall provide an instructional briefing meeting for all drivers and transportation subcontractors before work begins. The meeting shall cover the following topics at a minimum:

1. Onsite routing.

2. Weighing and weight tickets.

3. Procedures for cargo compartment lining, tarping, and decontamination.

4. Health and safety including respiratory requirements.

B. The Contractor shall prepare a written record of this meeting. Duplicates of meeting record shall be given to each driver upon their first check-in at the Site.

3.02 NOTIFICATION OF DISPOSAL FACILITY

A. The Contractor shall implement procedures and designate personnel to notify disposal facilities upon departure of each transport vehicle from the site supplying the following information as a minimum:

1. Driver Name.

2. Truck Identification.

3. Designation of materials contained in load.

4. Estimated time of arrival at disposal facility.

3.03 DEMURRAGE

A. Transportation demurrage costs during loading at the Site and at the disposal facilities shall be borne by the Contractor and are not a cost reimbursed by the ECC Trust.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03200 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install all concrete reinforcement as shown on the Drawings and specified herein.

1.02 RELATED SECTIONS

A. Section 03300 - CAST-IN-PLACE CONCRETE.

1.03 REFERENCE STANDARDS

A. Steel reinforcement in concrete shall conform to ACI 350 and ACI 318 unless otherwise specified herein.

1.04 PRODUCT DELIVERY AND HANDLING

A. Reinforcing shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.

B. Reinforcement shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same designations as shown on the submitted placing drawings.

C. Reinforcing steel shall be stored off the ground and shall be protected from moisture and kept free from dirt, oil, or injurious contaminants.

1.05 SUBMITTALS

A. Manufacturer's Certification of Product.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials shall be new, be of domestic manufacturer, and shall conform to the following material specifications.

1. Concrete reinforcing bars: ASTM A615, Grade 60.

2. Welded steel wire fabric: ASTM A185.

3. Plastic protected bar supports: CRSI Bar Support Specifications, Class 1 - Maximum Protection.

4. Precast concrete block bar supports: CRSI Bar Support Specifications, Precast Blocks with Wires.

5. Tie wires for reinforcement: 16-/12-gauge or heavier, black annealed wire.

B. The following alternate materials are allowed for deformed reinforcing bars:

1. "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement" (ASTM A615).

2. "Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement" including Supplementary Requirement S1 (ASTM A616 including S1).

3. "Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement" (ASTM A617).

4. "Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement" (ASTM A706).

2.02 FABRICATION OF REINFORCEMENT

A. Fabrication tolerances shall be in accordance with the CRSI, Code of Standard Practice-Fabrication.

B. Bars shall be cold bent.

C. Bars shall be bent around a revolving collar having a diameter of not less than that recommended by the CRSI, Code of Standard Practice-Detailing. Hooks shall conform to the same code.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Surface condition, bending, spacing, tolerances of placement of reinforcement shall conform to the CRSI, Code of Standard Practice-Field Erection.

B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:

1. Concrete cast against and permanently exposed to earth; 3-inch.

2. Concrete surfaces in contact with soil, water, sewage, sludge, or exposed to the weather; 2-inch.

3. Concrete surfaces not in contact with soil, water, sewage, sludge or exposed to the weather.

   Beams, girders, columns: principal reinforcement; ties; stirrups or spirals; 1-1/2-inch.

   Walls and bottom steel of slabs - 1 inch.

   Shells and top steel of slabs - 3/4-inch.

C. No reinforcing bars shall be welded either during the fabrication or erection unless specifically called for on the Drawings, specified herein, or with prior written approval of the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved, it shall conform to the AWS Structural Welding Code-Reinforcing Steel, AWD D1.4.

D. Reinforcing spacing design shall be coordinated with ACE 318-89 (revised 1992), titled "Building Code Requirements for Reinforced Concrete", Part 7.12.2.2

3.02 REINFORCEMENT AROUND OPENINGS

A. Place an equivalent area of steel to that interrupted by an opening, pipe penetration, or duct penetration around the opening or penetration. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

3.03 SPLICING

A. Splicing of concrete reinforcement shall be performed in accordance with the requirements set forth in ACE 318-89 (revised 1992), titled "Building Code Requirements for Reinforced Concrete".

B. Except as otherwise indicated on the Drawings, tension lap splices shall be in accordance with the applicable tables on the ACT 315, titled "Detailing Manual".

3.04 ACCESSORIES

A. The Contractor is solely responsible for determining, providing, and installing accessories such as chairs, chair bars, and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the steel and the placement of concrete.

B. Precast concrete blocks with wires shall be used where the reinforcing steel is to be supported over soil.

C. Stainless steel protected bar supports shall be used to firmly hold vertical reinforcement in position.

D. Precast concrete blocks with wires or plastic protected bar supports shall be used to support reinforcing steel on formwork. If the bottom of the precast blocks will be exposed to offer removal of forms, the color and appearance of the block shall match that of the adjacent concrete.

E. Alternate method of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.05 INSPECTION

A. In no case shall any reinforcing steel be covered with concrete until the amount and position of the reinforcement has been checked by the Engineer and his permission given to proceed with the concreting. The Engineer shall be given ample prior notice of the availability of set reinforcement for checking.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to place all concrete, reinforcing steel, forms, waterstops, grouting of base and bearing plates, electrical dust encasement, and miscellaneous related items including sleeves, reglets, anchor bolts, inserts, and embedded items specified under other sections.

1.02 RELATED SECTIONS

A. Concrete reinforcement is included in Section 03200 - CONCRETE REINFORCEMENT.

B. Concrete finishes are included in Section 03350 - CONCRETE FINISHES.

1.03 DESCRIPTION

A. Concrete shall be of Portland cement, fine aggregate, coarse aggregate, water, and admixtures as specified and shall be ready-mixed, or transit-mixed concrete produced by a plant acceptable to the Engineer. All constituents, including admixture, shall be batched at the central batch plant.

B. Reinforced concrete shall conform to ACI Specification 318.

C. All testing and inspection services required will be provided by a laboratory selected by the Contractor and approved by the Engineer. Cost of such work will be paid for by the Contractor. Methods of test will comply in detail with the latest applicable ASTM Methods of Test.

D. Samples of constituents and of concrete as placed will be subjected to laboratory tests. All materials incorporated in the work shall conform to approved samples.

1.04 QUALITY ASSURANCE

A. The actual acceptance of aggregates and development of mix proportions to produce concrete conforming to the specific requirements shall be determined by means of prior laboratory tests made with the constituents to be used on the work.

B. Well in advance of placing concrete, the Contractor shall discuss with the Engineer the proposed source of materials and concrete mixture which he proposes to use. He shall furnish samples of aggregate and cement for testing, deliver them to the laboratory selected, and shall permit ample time for the laboratory to develop a proposed design mix or to modify the design of the mix within the limits of these specifications.

C. The following limiting strengths, water-cement rations and cement factors shall apply:

TABLE A		
Minimum Comp. Str. psi at 28 days	Maximum Net Water Content gals/100 lbs.*	Minimum Cement Factor 100 lbs/cu yd**
2500	7.4	4.3
3500	6.4	5.2

* Maximum; decrease if possible. This represents total water in mix at time of mixing, including free water on aggregates, and water in admixture solution.

** Minimum; increase as necessary to meet other requirements. These cement factors apply to "controlled" concrete subject to specific inspection.

When high-early-strength Portland cement is permitted, the same strength requirements shall apply except that the indicated strengths shall be attained at 7 days instead of 28 days.

D. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineering may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the Contractor's expense.

E. If, during the progress of the work, the Contractor desires to use materials other than those approved (originally), or if the materials from the source originally approved change in characteristics, the Contractor shall, at his expense, have made new acceptance tests of aggregates and establishment of new basic mixtures by the approved testing laboratory being employed on the work. Objectionable changes in color of the structure shall not result form these modifications.

F. Consistence of the concrete as measured by the ASTM Designation C143 shall be as shown in Table B.

TABLE B		
	Slump (inches)	
Portion of Structure	Recommended	Range
Pavement and slabs on ground	2	1 - 3
Plain footings, gravity walls, slabs, and beams	2 - 3	1 - 4
Heavy reinforced foundation walls and footings	3 - 4	2 - 5
Thin reinforced wall and columns	4	3 - 5

G. Concrete shall be of such consistency and mix composition that it can be readily worked into the corners and angles of the forms and aground the reinforcement, inserts, and wall castings without permitting materials to segregate or free water to collect on the surface, due consideration being given to the methods of placing and compacting.

H. No excessively wet concrete will be permitted, and if at any time concrete of such consistency beyond the limits of Table B is delivered to the job, the Engineer may direct the Contractor to reject same or to add extra cement for which no additional payment will be made. A supply of cement shall be kept available at the Site for this purpose. No additional water shall be added by drivers of transit-mix trucks except that established for the design. Failure to comply with this requirement shall be justification for rejecting the concrete.

I. The entrained air, as measured by the Pressure Method, ASTM C231, shall be:

TABLE C	
Location	Total Air Measured at Discharge from Truck (%)
Finished slabs	3.0 maximum
All other	3.5 - 5.0

1.05 ACCEPTANCE TESTS

A. Conformity of aggregates to these Specifications, and the actual proportions of cement, aggregates, and water necessary to produce concrete conforming to the requirements set forth in Table A, shall be determined by tests made with representative samples of the materials to be used on the work. Tests will be made by the approved laboratory.

B. Cement shall be subject to testing to determine that it conforms to the requirements of this Specification if it is required by the Engineer.

C. Samples of fine and coarse aggregates shall be furnished for examination and testing at least 3 weeks before the Contractor proposes to use them in the work.

D. Water content of the concrete shall be based on a curve showing the relation between water content and 7- and 28-day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age, and shall have a range of values sufficient to yield the desired data, including all the compressive strengths called for on the plans, without extrapolation. The water content of the concrete to be used, as determined from the curve, shall correspond to the following test strengths of the laboratory trial mixtures:

TABLE D		
Design Strength	Min. Lab. 7 Days*	Strength 28 Days**
2500	2000	2900
3500	3000	4100

* May be employed for preliminary design.
** To be used for final designs.

E. In no case, however, shall the resulting mix conflict with the limiting values for maximum water-cement ratios and minimum cement contents as specified in Table A.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials shall conform to these Specifications and any state or local specification requirements.

B. Cement for all cast-in-place concrete shall be a domestic Portland cement (ASTM C-150, Type II) or high early strength Portland cement (ASTM C-150, Type III) free from injurious water soluble salts or alkalies. High early strength cement may only be used with written approval of the Engineer. Air entraining cements shall not be used. Cement brands shall be subject to approval of the Engineer.

C. Aggregates

1. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM Specification C-33, and the following detailed requirements:

Sieve	Retained
No. 4	0 - 5 percent
16	25 - 40
50	70 - 87
100	93 - 97
Fineness Modulus	2.60 - 3.00
Organic	See Plate 2, ASTM C40
Silt	2.0 percent maximum
Mortar Strength	95 percent minimum as per C87 Section 10.
Soundness	8 percent maximum loss, using magnesium sulfate, subjected to 5 cycles

2. Course aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM Specification C-33 and the following detailed requirements.

Organic	See Plate 1, ASTM C40
Silt	1.0 percent maximum
Soundness	8 percent maximum loss, using magnesium sulfate, subjected to 5 cycles

3. The following designated sizes of aggregate shall be the maximum employed in concrete:

   2-inch for plain concrete
   1-inch for reinforced section 10-inch and over in thickness
   3/4-inch for reinforced sections less than 10-inch thickness

4. Note:

The "Designated Size" and the corresponding gradations shown represent the end or combined gradation of the coarse aggregate to be used in the final concrete.

D. Water

1. Water shall be clean and free from injurious amounts of oils, acid, alkali, organic matter, or other deleterious substances.

2. When subjected to the mortar strength test described in ASTM C87, the 28-day strength of mortar specimens made with the water under examination and normal Portland cement shall be at least 100 percent of the strength of similar specimens made with distilled water.

3. Potable tap water will normally fulfill the above requirements.

E. Admixtures

1. A water reducing agent shall be used in all concrete. The admixture shall conform to ASTM Specification C494, Type A. Proportioning and mixing shall be as recommended by the manufacturer.

2. Admixtures causing accelerated setting of cement in concrete shall not be used. Air entraining admixtures with demonstrated compatibility with the concrete mix shall be used as required as a moderate addition to the water reducing agent to obtain the specified percent air in the resultant concrete.

F. Grout

1. Grout for setting bearing plates for structural steel machinery, and other equipment shall be mixed as recommended by the manufacturer to give the necessary consistency for placing and to give a minimum compressive strength of 3,000 psi in 3 days and 6,800 psi in 28 days.

2. Non-shrink grout shall be Masterflow 713 as manufactured by the Master Builders Company, Euco N-S by Euclid Chemical Company, Five Star Grout by U.S. Grout Corporation, or equal.

PART 3 - EXECUTION

3.01 MEASURING MATERIALS

A. Materials shall be measured by weighing except as otherwise specified or where other methods are specifically authorized by the Engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Scales shall have been certified by the local Sealer of Weights and Measures within 1 year of use. Each size of aggregate and the cement shall be weighted separately. The accuracy of all weighing devices shall be such that successive quantities can be measured to within 1 percent of the desired amount. Cement in standard packages (sacks) need not be weighted, but bulk cement and fractional packages shall be weighted.

B. Water shall be measured by volume or by weight. The water-measuring device shall be capable of control to ½ percent accuracy. All measuring devices shall be subject to approval. Admixtures shall be dispensed either manually with use of calibrated containers or measuring tanks, or by means of an approved automatic dispenser designed by the manufacturer of the specific admixture.

3.02 MIXING

A. Concrete shall be ready-mixed, or transit-mixed, as produced by equipment acceptable to the Engineer. No hand-mixing will be permitted. Adding water in controlled amounts during the mixing cycle shall be done only with the express approval of, and under the direction of, the Engineer.

B. Ready-mix or transit-mix concrete shall be transported to the Site in watertight agitator or mixer trucks loaded not in excess of rated capacities for the respective conditions as stated on the name plate. Discharge at the Site shall be within 1-1/2 hours after cement was first introduced into the mix. Central mixed concrete shall be plant-mixed a minimum of 1-1/2 minutes per batch and then shall be truck-mixed or agitated a minimum of 8 minutes. Agitation shall begin immediately after the pre-mixed concrete is placed in the truck and shall continue without interruption until discharge. Transit-mixed concrete shall be mixed at mixing speed for at least 10 minutes immediately after charging the truck, followed by agitation without interruption until discharged.

C. All central plant and rolling stock equipment and methods shall conform to the latest Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers' Bureau of the National Ready-Mixed Concrete Association, as well as ACI Standard 614 and ASTM Specification C94.

D. The retempering of concrete or mortar which has partially hardened, that is, mixing with or without additional cement, aggregate, or water, will not be permitted.

E. Attention is called to the importance of dispatching trucks from the batching plant so that they shall arrive at the Site of the work just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.

3.03 FIELD TESTS

A. Sets of three field control cylinder specimens will be taken at random by the Contractor at the request of the Engineer during the progress of the work, in conformity with ASTM Designation C31; the total number of specimens taken on the project may average one set per 150 cubic yards, and in general, not less than one set of specimens will be taken on any 1 day when concrete is placed. The cylinders shall be tested by the selected laboratory and the results submitted to the Engineer. When average ultimate 28-day strength of control cylinders in any set falls below the required ultimate strength or below proportional minimum 7-day strengths where proper relation between 7- and 28-day strengths have bene established by tests, proportions, water content, or temperature conditions shall be changed to secure the required strength.

B. The Contractor shall cooperate in the making of such tests to the extent of allowing free access to the work for the selection of samples, providing heated moist storage facilities for specimens, affording protection to the specimens against injury or loss through his operations, and furnishing material and labor required for the purpose of taking concrete cylinder samples, curing boxes, and shipping boxes.

C. Slump tests will be made in the field by the Contractor.

D. The Engineer will retain the right to perform any tests, inspections, etc., as he deems necessary. The Contractor shall provide concrete cylinders as necessary for the Quality Assurance tests.

3.04 INSPECTION AND CONTROL

A. The preparation of forms, placing of reinforcing steel, conduits, pipes, and sleeves, batching, mixing, transportation, placing and curing of concrete shall be at all times under the inspection of the Engineer.

B. The Contractor will also engage the services of a testing laboratory to establish the basic mixtures of concrete as required by the specifications.

C. Air entrainment shall be measured by the Contractor at time of concrete deposit in accordance with ASTM Designation C231.

3.05 CONCRETE APPEARANCE

A. Concrete for every part of the work shall be of homogeneous structure which, when hardened, will have the required strength, durability, and appearance.

B. Formwork, mixtures, and workmanship shall be such that concrete surfaces, when exposed, will require no finishing.

3.06 FORMS

A. Forms shall be used for all concrete masonry, including footings. Forms shall be so constructed and placed that the resulting concrete will be of the shape, lines, dimensions, appearance, and to the elevations indicated on the Drawings.

B. Forms for all exposed exterior and interior concrete walls shall be B-B Plyform Class I exterior plywood, mill oiled and edge sealed. For curved walls, provide approved curved form material to provide the smooth radius shown. Moldings for chamfers and rustications shall be milled and planed smooth.

C. Forms for all other cast-in-place concrete shall be made of wood, metal, or other approved material. Wood forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots; where used for exposed surfaces, boards shall be dressed and matched. Plywood shall be sanded smooth and fitted with tight joints between panels. Metal forms shall be of an approved type for the class of work involved and of the thickness and design required for rigid construction.

D. Edges of all form panels in contact with concrete shall be flush within 1/32-inch and forms for plane surfaces shall be such that the concrete will be plane within 1/16-inch in 4 feet. Forms shall be tight to prevent the passage of mortar and water and grout.

E. Molding or bevels shall be placed to produce a 3/4-inch chamfer on all exposed projecting corners. Approved chamfer strips shall be provided at horizontal and vertical extremities of all wall placements to produce "clean" separation between successive placements shown.

F. Forms shall be sufficiently rigid to withstand vibration, to prevent displacement or sagging between supports, and constructed so the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for their adequacy.

G. Forms, including new pre-oiled forms, shall be oiled before reinforcement is placed, with an approved nonstaining oil or liquid form coating not having a paraffin base.

H. Before form material is reused, all surfaces in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn, all protrusions smoothed and in the case of wood forms pre-oiled.

I. Form ties encased in concrete shall be designed so that after removal of the projecting part, no metal shall be within 1-inch of the face of the concrete. That part of the tie to be removed shall be at least ½-inch diameter or be provided with a wood or metal cone at least ½-inch in diameter and 1-inch long. Form ties in concrete exposed to view shall be the cone-washer type. Throughbolts or common wire shall not be used for form ties.

3.07 PLACING AND COMPACTING

A. Unless otherwise permitted, the work begun on any day shall be completed in daylight of the same day.

B. Place no concrete until reinforcing steel, pipes, conduits, sleeves, hangers, anchors, and other work required to be built into concrete have been inspected and approved by the Engineer. Remove water and foreign matter from forms and excavation. Place no concrete on frozen soil, and provide adequate protection against frost action during freezing weather. All soil bottom for slabs and footings shall be approved by the Engineer before placing concrete.

C. Transport concrete from mixer to place of final deposit as rapidly as practicable by methods which prevent separation of ingredients and displacement of reinforcement, and which avoid rehandling. Deposit no partially hardened concrete.

D. "Cold joints" are to be avoided, but if they occur, are to be treated as bonded construction joints.

E. At construction joints the surfaces of the concrete already placed, including vertical and inclined surfaces, shall be thoroughly cleaned of foreign materials and laitance, and weak concrete and roughened with suitable tools to expose a fresh face. At least 2 hours before and again shortly before the new concrete is deposited, the joints shall be saturated with water. After glistening water disappears, the joints shall be given a thorough coating of neat cement slurry mixed to the consistency of very heavy paste. The surfaces shall receive a coating at least 1/8-inch thick, well scrubbed-in by means of stiff bristle brushes whenever possible. New concrete shall be deposited before the neat cement dries.

F. Deposit concrete to maintain, until the completion of the unit, a horizontal plastic surface. Vertical lifts shall not exceed 24-inch and shall preferably be 18-inch.

G. Concrete during and immediately after depositing shall be thoroughly compacted by means of suitable tools. Internal type mechanical vibrators shall be employed to produce required quality of finish. Vibration shall be done by experienced operators under close supervision and shall be carried on long enough to produce homogeneity and optimum consolidation without permitting segregation of the solid constituents or "pumping" or migration of air. All vibrators shall be supplemented by proper wooden spade puddling adjacent to forms to remove included bubbles and honeycomb. This is essential for the top lifts of walls. All vibrators shall travel at least 10,000 rpm and be of adequate capacity. At least one vibrator shall be used for every 10 cubic yards of concrete placed per hour.

H. Concrete slabs on the ground shall be well-tamped into place and foundation material shall be wet, tamped, and rolled until thoroughly compacted prior to placing concrete.

I. Concrete shall be deposited continuously in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the section. If a section cannot be placed continuously, construction joints may be located at points as provided for in the Drawings or approved by the Engineer.

3.08 CURING AND PROTECTION

A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.

B. Concrete placed at air temperature below 40°F shall have a minimum temperature of 60°F. When the air temperature is below 40°F or near 40°F and falling, the water and aggregates shall be heated before mixing. Accelerating chemicals shall not be used to prevent freezing. All concrete shall be so protected that the temperature at the surface will not fall below 50°F for at least 7 days after placing. The Contractor shall submit for approval by the Engineer the methods he proposes to use against low temperatures. No salt, manure, or other chemicals shall be used for protection.

C. All concrete, particularly exposed surfaces, shall be treated immediately after concreting or cement finishing is completed to provide continuous moisture curing above 50°F for at least 7 days, regardless of the ambient air temperature. Walls and vertical surfaces may be covered with continuously saturated burlap, or other approved means; horizontal surfaces, slabs, etc., shall be ponded to a depth of ½-inch or kept continuously wet by use of sprinklers.

D. In cold weather, supplementary continuous warm curing (above 50°F) shall provide a total of 350-day degrees (i.e, 5 days 70°F, etc.) of heat.

E. Wherever practicable, finished surface and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

3.09 REMOVAL OF FORMS

A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 30 percent of the ultimate strength prescribed by the design, and not before reaching the following number of day-degrees (whichever is the longer):

Forms for	Day-Degree*
Beams and slabs	500
Walls and vertical surfaces	100

* Day-Degree: Total number of days times average daily air temperature at surface of concrete. For example, 5 days at a daily weighted average temperature of 60°F equal 300 day-degrees. Temperatures below 50°F not to be included.

B. Shores shall not be removed until the concrete has attained at least 60 percent of the specified strength and also sufficient strength to support safely its own weight at the construction live loads upon it.

3.10 FAILURE TO MEET REQUIREMENTS

A. Should the strengths shown by the test specimens made and tested in accordance with the above provisions fall below the values given in Table A, the Engineer shall have the right to require changes in proportions as outlined above to apply on the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed, the cost of such additional curing to be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements, the Contractor and Engineer shall confer to determine what adjustment, if any can be made in conformity with Sections 15 and 17 of ASTM Specification C94 for Ready-Mixed Concrete.

B. When the rests on control specimens of concrete fall below the required strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in accordance with ASTM Methods C42 and C39. In case of failure of the latter, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on anyone of the slabs, beams, piles, caps, and columns in which such concrete was used. Test need not be made until concrete has aged 60 days.

3.11 PATCHING AND REPAIRS

A. It is the intent of these Specifications to require forms, mixture of concrete and workmanship so that concrete surfaces, when exposed, will require no patching.

B. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed, recesses left by the removal of form ties shall be filled except as specified below, and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.

C. Immediately after stripping of forms, remove tie cones and break off metal ties except where required below to be left in place. Holes are then to be promptly filled upon stripping as follows: moisten the hole with water, followed by a 1/16-inch brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1-1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.

3.12 INSTALLATION SCHEDULE

A. Concrete for all structures shall have minimum compressive strength at 28 days of 3,500 psi.

3.13 MISCELLANEOUS WORK

A. All bolts, anchors, miscellaneous metals, or other sleeve steel work required to be set in the concrete forms for attachment of masonry, structural, and mechanical equipment shall be set or installed under this Division. The Contractor shall be fully responsible for the setting of such materials in the forms and shall correct all such not installed in a proper location or manner at his own expense.

B. Electric conduits shall be installed in the concrete as required by the Drawings and specified elsewhere in these Specifications. Outlet boxes and fixtures shall be located in reference to the final floor, wall, or ceiling finish and shall be so secured that they will not be displaced by concrete placing.

C. Pipes or conduits for embedment, other than those merely passing through shall not be larger in outside diameter than one-third the thickness of the slab, wall, or beam in which they are embedded, unless indicated on the Drawings, nor shall they be spaced closer than three diameters on center, nor so located as to unduly impair the strength of the construction. The Engineer shall approve the location of all conduits and fixtures.

D. Concrete foundations, supports, and bases for all equipment and machinery shall be built to the equipment manufacturer's requirements, as approved by the Engineer, with anchor bolts installed.

3.14 FIELD CONTROL

A. The Contractor shall advise the Engineer of his readiness to proceed at least 6 working hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing and the alignment and tightness of formwork. No placement shall be made without the prior approval of the Engineer.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03350 - CONCRETE FINISHES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to finish cast-in-place concrete surfaces as specified herein.

1.02 RELATED SECTIONS

A. Patching and repair of defective and honeycombed concrete is included in Section 03300 - CAST-IN-PLACE CONCRETE.

1.03 SCHEDULE OF FINISHES

A. Concrete for the project shall be finished in the various specified manners either to remain as natural concrete or to receive an additional applied finish or material under another Section.

B. Finishes to the base concrete for the following conditions shall be finished as noted and as further specified herein:

1. Concrete to receive dampproofing - Off-form finish.

2. Exterior concrete and exposed interior concrete - rubbed finish as approved.

3. Concrete not exposed in the finished work and not scheduled to receive an additional applied finish - Off-form finish.

1.04 RESPONSIBILITY FOR CHANGING FINISHES

A. The surface finishes specified herein are required for the proper application of products specified under other Sections. Where products different from those specified are approved for use, it shall be the Contractor's responsibility to determine if changes in concrete finishes are required and to provide them at not additional cost to the ECC Trust.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cementitious and component materials required for finishing with the concrete surfaces shall be specified in Section 03300 - CAST-IN-PLACE CONCRETE.

PART 3 - EXECUTION

3.01 FORMED SURFACES

A. Forms shall not be stripped before the provisions of Section 03300, Paragraph 3.08A have been met.

B. Care shall be exercised to prevent damaging of surfaces or edges or obliterating the lines of chamfers, rustications, or corners when removing the forms or doing any other work adjacent thereto.

C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to the satisfaction of the Engineer.

D. Concrete to receive dampproofing and concrete not exposed in the finished work shall have off-form finish with fins and other projections removed and tie cones and defects filled as specified under Section 03300 - CAST-IN-PLACE CONCRETE.

3.02 FLOORS AND SLABS

A. Floors and slabs shall be screened to the established grades and shall be level with a tolerance of 1/8-inch when checked with a 12-foot straightedge, except where drains occur, in which case floors shall be pitched to drains as indicated. Failure to meet either of above shall be cause for removal, grinding, or other correction as directed by the Engineer.

B. After procedure specified in Paragraph 3.02A is accomplished, floors and slabs for particular conditions shall be finished as specified in the Paragraphs 3.02C and 3.02D.

C. Wood float where required maintaining surface tolerances to provide a non-slip finish as approved.

D. Concrete for exterior, non-submerged service shall be broomed in the direction of slab drainage maintaining the surface tolerance to provide a non-slip finish as approved.

3.03 APPROVAL OF FINISHES

A. All concrete surfaces, when finished, will be inspected by the Engineer.

B. Surfaces which, in the opinion of the Engineer, are unsatisfactory shall be refinished or reworked until approved by the Engineer.

END OF SECTION

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13050 - WASTEWATER STORAGE AND TRANSFER SYSTEM

(Rev. 3, 08/14/97)

PART 1 - GENERAL

1.01 GENERAL

A. The Contractor shall provide all labor, equipment and materials to construct and operate an onsite storage and transfer system for wastewaters generated during construction and operation of the remedial actions. The wastewater storage system includes a total of four modular tanks for storage of both raw and treated wastewaters. The transfer system includes pumps, piping and controls as needed to convey treated waters from the storage tanks to either an on-site channel for discharge, to a tanker for hauling to an off-site disposal facility, or to the raw water storage tanks for retreatment. The transfer pumps shall be housed in a transfer building.

The process flow and instrumentation diagram (P&ID) for the wastewater storage and transfer system is shown on the Drawings.

1.02 RELATED SECTIONS

A. Section 02900 - OFFSITE TRANSPORTATION AND DISPOSAL

B. Section 13110 - WASTEWATER TREATMENT SYSTEM

C. Section 13150 - STRUCTURES

1.03 SUBMITTALS

A. The Contractor shall provide the following submittals to the Engineer in accordance with Section 01300 - SUBMITTALS.

B. Product Data: Manufacturer's product data for all major components of the wastewater storage and transfer systems, including:

1. Tank wall, frame supports and rail.

2. Tank liner and cover materials.

3. Piping and pipe fittings.

4. Transfer pumps and controls.

5. Instrumentation and controls.

6. Access stairways.

7. Tank vent (T2) treatment system.

C. Shop Drawings

1. Manufacturer's published detailed drawings, modified to suit design conditions as necessary, and Contractor's prepared drawings as applicable, depicting inlet piping connections and supports, bottom drains, leak detection drains and sumps, transfer pumping systems and spill control.

2. Contractor-designed pond inlets for construction dewatering, and SVE system wastewaters.

D. Installation Instructions

1. Manufacturer's installation instructions for the wastewater storage tank system.

PART 2 - PRODUCTS

2.01 WASTEWATER STORAGE TANKS

A. The Contractor shall provide four steel Storage tanks, each 43-foot diameter by 15-foot high (nominal 150,000 gallon capacity each) with a total volume of 600,000 gallons capacity as measured at 6-inch freeboard. The tanks shall be ModuTank HiStor Storage tanks, or equivalent, as manufactured by:

ModuTank, Inc.
Long Island City, New York 11101
(800) 245-6964

ModuTank shall provide the tank steel and hardware, the tank liners, cover (T2 only), and geotextiles, and the bottom drain and leak detection fitting assemblies. All other site preparation materials and piping shall be provided by the Contractor.

B. Tanks shall be free-standing and self supporting. The tanks shall be able to be installed on a level, compacted earth site. The tank wall shall be placed on a perimeter ring footer consisting of IDOH No. 5 coarse aggregate approximately 48-inches wide and 12-inches deep.

C. The tanks shall consist of modular steel components and be shipped as a Knock-Down (KD) unit and be assembled using simple hand tools.

D. The tank walls shall be set on steel footing plates placed directly on the ring footer. The footing plates shall be 24 x 30 x 3/16" CORTEN steel per ASTM A606. The plates shall be anchored on the outside of the tank wall with a concrete block or equivalent dead weight which provides a minimum 300-pound load per plate.

E. Tank walls shall be 12 gauge LFQ G-90 Mill Galvanized Steel panels per ASTM A-569, 5 x 10 feet dimension. Wall support girths shall be 3-inches x 3-inches x 3/16-inch structural steel angle, hot dip galvanized after fabrication. The girths shall be ASTM A-36 structural steel angles. The girths shall be placed horizontally to connect the wall panels and will consist of one bottom girth, two middle girths, and a top girth.

F. Wall and support frames shall be bolted together using bolts, nuts and washers to be supplied by the tank vendor.

G. The tanks shall be arranged in series. The first two tanks in series designated Tanks T1 and T2 shall receive all raw waste waters generated from the site activities. The last two tanks in series designated Tanks T3 and T4 shall receive all treated water from the Wastewater Treatment System. The Wastewater Treatment System shall be located between the raw and treated wastewater storage tanks. Tank T4 piping shall be arranged to return wastewaters to Tank T1 for retreatment, if necessary.

2.02 TANK LINER SYSTEM

A. Each storage tank shall have a double-liner construction for dual containment of liquids. The liner shall be shop-fabricated in one piece to fit each tank. The liners shall be as follows:

1. Primary (top) Liner: 30 mil reinforced XR-5.

2. Secondary (bottom) Liner: 30 mil reinforced XR-5.

B. A leak detection geotextile shall be placed continuously between the primary and secondary liners. The secondary liner shall have a continuous geotextile underlayment on the subbase. The geotextiles are described in Section 02280 - GEOTEXTILES.

2.03 PIPING

A. Bottom Drain: Each tank shall have a 4-inch diameter Schedule 80 PVC bottom drain. Tanks T2 and T4 shall have two bottom drains to allow interconnection with their companion tanks. The bottom drains shall be installed in accordance with the manufacturer's recommendation and be placed in a 3-foot deep trench as shown on the Drawings. The bottom drain shall have a 4-inch diameter stickup screened to minimize solids and debris entry into the drain.

B. Leak Detection System: Each tank shall have a 4-inch diameter Schedule 80 PVC leak detection drain that connects to a vertical 12-inch diameter Schedule 80 PVC sump. The leak detection drains shall be installed in accordance with the manufacturer's recommendations. The drain pipes shall be placed in a 3-foot deep trench and be sloped at 1 percent to the sump. The sump shall stickup 6-inches above the tank wall and shall be capped. The sump shall be located as shown on the Drawings.

C. Inlet Pipe: All inlet pipes into each tank shall be over the top of the tank wall, with the exception of bottom drain tank connections for Tanks T1 and T2 and Tanks T3 and T4. The inlet pipe to the transfer Tank T3 from the wastewater treatment system shall be 4-inch Schedule 80 PVC constructed with a twin-diffuser outlet on the tank bottom as indicated on the Drawings. An XR-5 lined splash pad shall be placed on the primary liner beneath the diffuser outlet.

D. Inlets from the leak detection sumps and SVE treatment system shall be hard-piped over the Tank T1 wall. Sump inlets shall be as indicated on the drawings. Construction dewatering inlets shall be temporary piping over the Tank T1 wall. Inlets for SVE treatment systems and construction dewatering shall be as determined by the Contractor and approved by the Engineer.

E. Discharge from the wastewater transfer system pump (P200) shall be into a 50-foot flexible 2-inch diameter PVC or rubber water discharge hose with aluminum shank couplings suitable for direct connection to bottom fill tanker trucks. A 2-inch diameter PVC return line shall be constructed from the transfer pump to storage tank T1 to allow for retreatment of water, if needed.

2.04 PUMPS

A. Wastewater Transfer Pumps

1. The wastewater treatment pumps (2) shall be stainless steel end suction pumps, Model: 5ST52035AV as manufactured by:

Goulds Pumps, Inc.
Seneca Falls, NY
(315) 568-2811

2. These pumps shall meet the following design requirements and functional characteristics:

   a. 100 gpm @ 40 ft. TDH
   b. 1½-inch intake - flanged
   c. 2½-inch discharge - flanged
   d. 1750 RPM operating speed
   e. 460 volt 3-phase power
   f. 1½ horsepower rating
   g. stainless steel wetted parts
   h. Fully-enclosed leakproof motor
   i. 6½-inch impeller
   j. Viton and ceramic seals
   k. Close-coupled design

B. Sump Pumps

1. The wastewater storage pad and decontamination pad pumps shall be portable electric submersible pumps sized and selected by the Contractor to transfer collected water to the wastewater storage Tank T1.

2. The discharge hoses from the portable submersible pumps shall be continuous leak free flexible PVC or rubber water discharge hose. The discharge hoses shall be rigidly fastened to the Tank T1.

C. Spare Pumps and Motors

1. The Contractor shall provide an on-site spare transfer pump and an additional spare motor. The piping connections to the wastewater transfer pumps shall be able to be quickly disconnected and attached to a portable diesel-driven pump, if needed.

2.05 INSTRUMENTATION AND CONTROLS

A. Control Panels

1. The wastewater transfer system controls shall be housed in a panel as shown on the Drawings.

B. Level Control Switches

1. Level control switches shall be float or mercury type switches which control pump operation.

2. Level control switches shall be one each rigidly attached or hung from the top brace of Tanks T3 and T4.

3. The level control switches shall be installed and/or calibrated to shut down the wastewater transfer pump if any of the following conditions are met:

    a. Water level in the wastewater storage Tanks T3 or T4 dropping to 12-inches above the floor drain.

    b. Water level in the wastewater storage Tanks T1 or T2 rising to 12-inches below top of the sidewall rail.

C. Instrumentation

1. The wastewater storage and transfer system shall include the following locally mounted instruments:

    a. Pressure Gauge - Analog style pressure gauge, stainless steel body, minimum 2½-inch diameter. Pressure gauge shall have a range of 0 to 150 psig. Accuracy shall be ±1±% of range.

    b. Water Meter/Totalizer - shall be nutating disc meter model: RCDL M-120 as manufactured by:

        Badger Meter, Inc.
        4545 W. Brown Deer Road
        Milwaukee, WI 53223-0099
        (414) 355-0400

2.06 TANK T2 COVER AND VENT TREATMENT

A. Storage Tank T2 will be equipped with a floating cover and vent treatment system to control VOC vapor emissions from the stored wastewater. The tank cover shall be constructed as indicated on the drawings and shall include the following components:

1. Floating cover fabricated of 30 mil reinforced XR-5, incorporating floatation logs, ballast pipe, protective liner bumper, and rope retention grid.

2. Vent assembly consisting of two (2) four-inch diameter vents, flexible hose, and over-the-wall piping.

The tank cover and vent assembly shall be as manufactured by ModuTank, Inc., or equivalent, and shall be compatible for construction and operation with the wastewater storage tank.

B. Tank vent T2 discharge shall be conveyed to an activated carbon treatment system. Two 55-gallon VentSorb canisters connected in series, as manufactured by Calgon Carbon Corporation, Pittsburgh, Pennsylvania, or equivalent, shall be used. The canisters shall be situated along the outside wall of Tank T2 in a location approved by the Engineer. A standby clean canister shall be kept onsite for replacement, as needed.

The vent treatment system shall include a condensate drain and storage tank (minimum 55-gallon) upflow of the carbon canisters to remove moisture. A sample valve shall be located between the canisters to allow routine vapor testing for VOC breakthrough.

2.07 MISCELLANEOUS

A. Access Stairways – The Contractor shall construct common access stairways between Tanks T1 and T2, and Tanks T3 and T4. The stairways shall be built of outdoor grade lumber and shall comply with applicable OSHA standards the stairways shall have a platform that will permit viewing into either tank adjacent to the platform.

PART 3 - EXECUTION

3.01 SITE PREPARATION

A. The wastewater storage and transfer system shall be located within the Support Zone as shown on the Drawings. The existing aggregate paving shall be left in place and covered with a geotextile. The aggregate shall be leveled and compacted to a smooth finish to achieve a subbase elevation ± 0.1 foot across each tank footprint, including the wall supports.

3.02 PIPING AND TANK INSTALLATION

A. The bottom drains and leak detection piping systems shall be installed prior to tank construction as described on the Drawings. The leak detection system pump shall discharge into Tank T1.

The tanks and liner systems shall be installed in accordance with the manufacturer's recommendations as approved by the Engineer.

3.03 OPERATIONS

A. The wastewater storage and transfer systems shall be constructed and all quality control inspections shall be completed prior to starting construction dewatering.

B. The Contractor shall provide pumps and piping as needed to convey construction waters to the storage Tank T1. All waters shall be pumped into the Tank T1.

The Contractor shall monitor the water level in all tanks (T1 - T4). When the water level reaches 65% of the maximum operating water level in Tank T1, the wastewater treatment plant operator shall be present to commence wastewater treatment operations.

C. Maximum operating water levels in the tanks shall be at 12-inches below the top of the sidewall rail. No waters shall be transferred into a tank that has reached it's maximum water level.

For the periods during excavation and construction dewatering when the pumping rate exceeds 5,000 gallons per day, the Contractor shall keep the wastewater treatment plant operator informed on a daily basis as to observed tank levels and expected pumping rates.

Waters encountered during construction at a volume in excess of that which can be transferred into the tanks shall be temporarily stored by the Contractor by a means approved by the Engineer.

D. Solids Removal and Handling

1. The Contractor shall be responsible for removal and containerization of all solids collected in the storage tanks during the duration of remediation activities. Settled solids shall be removed if the settled volume exceeds 15 percent of the capacity of the Tank.

2. All solids and residues collected during cleaning of the storage tanks shall be managed by the Contractor as described in Section 02080 - REMEDIAL ACTION GENERATED WASTES.

E. Vent Treatment System at Tank T2.

The carbon canister vent treatment system shall be operated in the lead/lag mode. The lead canister discharge shall be monitored on a minimum weekly basis during operation of the wastewater treatment system. A photoionization detector (PID) shall be used to measure total VOCs emitting from the sample valve between the canisters. Breakthrough shall be designated as a PID VOC measurement of 10 ppm.

Upon determination of VOC breakthrough, the lead canister shall be repalced with the lag canister and a clean canister (standby) shall be installed as the lag canister.

3.04 DEMOBILIZATION.

A. The Contractor shall remove from the site all of the wastewater storage tank materials, with the exception of the ring footer and below-grade piping. Demobilization shall be in accordance with Specification 01710 - DEMOBILIZATION.

END OF SECTION

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13100 - SOIL VAPOR EXTRACTION SYSTEM

(Rev. 3, 08/14/97)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Soil vapor collection piping and associated mechanical equipment.

B. Soil vapor lateral piping, header piping, and associated mechanical equipment.

C. Air-water separator(s).

D. SVE system blower(s).

E. SVE system heat exchanger(s)(optional).

F. Vapor treatment unit(s).

G. Instrumentation and controls.

1.02 RELATED SECTIONS

A. Attachment A - SUMMARY OF SITE SUBSURFACE CONDITIONS.

B. Attachment B - VOC ANALYSES OF SOIL SAMPLES.

C. Attachment C - SOIL VAPOR EXTRACTION PILOT TEST REPORT.

D. Section 01392 - ENVIRONMENTAL SAMPLING AND QUALITY ASSURANCE.

E. Section 02200 - EARTHWORK.

F. Section 13200 - SOIL VAPOR EXTRACTION SYSTEM OPERATIONS START-UP .

G. Section 13210 - SITE OPERATIONS AND MAINTENANCE.

I. Section 13050 - WASTEWATER STORAGE AND TRANSFER SYSTEMS.

J. Section 16000 - GENERAL ELECTRICAL.

K. Section 16400 - ELECTRICAL SERVICE AND DISTRIBUTION.

L. Section 16600 - SPECIAL SYSTEMS.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

ASTM A 36 (1988; Rev. C); Structural Steel

ASTM D 1785 (1988); Poly (Vinyl Chloride) (PVC)
Plastic Pipe, Schedules 40, 80, 120

ASTM D 2241 (1988); Poly (Vinyl Chloride) (PVC)
Pressure Rated Pipe (SDR Series)

ASTM D 2464 (1988); Threaded Poly (Vinyl Chloride) (PVC)
Plastic Pipe Fittings, Schedule 80

B. Manufacturing Standardization Society of the Valve and
Fittings Industry, Inc. (MSS)

MSS SP-58 (1983); Pipe Hangers and Supports-Materials
Design and Manufacture

C. National Electrical Manufacturers Association (NEMA)

NEMA 250 (1985 including Rev. 1 and 2 and ICS -6); Enclosures
for Electrical Equipment (1000 volts max.)

D. Plastic Pipe Institute (PPI)

PPI 01 (1976; 1st Edition); Plants Piping Manual

E. ANSI/National Fire Protection Association (NFPA)

ANSI/NFPA 70; 1990 National Electric Code

1.04 SYSTEM DESCRIPTION

A. Provide a Soil Vapor Extraction (SVE) System comprised of the following:

1. SVE System General Description - The SVE system shall systematically move air through the zone of contamination to enhance volatilization and removal of volatile organics. Air movement through the soil and crushed concrete and aggregate shall be controlled by either a network of trenches, wellpoints, a combination of both or some other means. The SVE process shall involve the continuous extraction of organics-laden air and treatment of the air by a vapor treatment unit to remove organics. The organics so collected shall then be destroyed offsite.

The SVE system shall address differences in the physical characteristics of the in-situ soils, soils fills, and crushed concrete and aggregate fill, including particle size, density, moisture content, porosity, and pneumatic/hydraulic conductivity. Separate SVE methods may be applied to the different zones intended for treatment, if deemed appropriate by the Contractor.

The SVE system shall also be able to remove water and water vapor encountered within the zone of treatment and any leachate water present in the contaminated fill during construction and operations without causing any interruptions in the SVE operations. The Contractor may employ a separate dewatering system or utilize the SVE vacuum system to remove waters produced in the zone of treatment.

The SVE vacuum system will be capable of developing a minimum vacuum of 20 inches Hg. The normal operating vacuum will be established by the SVE contractor. The Terra Vac pilot test at the ECC site results showed an initial radius of influence of 15 feet during trench development. Under continuous operation, the radius of influence increased to about 20 feet. The enhanced operating efficiency obtained by installing the SVE Stage 1 cover should increase the radius of influence to over 20 feet. To be conservative, for purposes of the design, the radius of influence will be assumed to be 18 feet.

The Terra Vac pilot study provides useful information that may be useful concerning the air permeability of in-situ soils, the area of influence of an applied vacuum pressure in soil, and the amount of VOCs removed. The Terra Vac pilot study, however, was conducted under site conditions that appear to have been unusually dry.

The design air volume (consistent with the Terra Vac pilot plant test results) criteria must provide at least one air volume change per soil pore volume per day. Based on an estimated area of treatment of approximately 115,400 square feet, a depth of 9 feet, and an average soil porosity of 20%, 200 SCFM would be the minimum air flow that meets the design.

The SVE system must be designed to be effective to a minimum depth of 9 feet, as measured from existing grade. If trenches are employed, they will be designed to allow for injection and/or extraction. The bottom elevation for both injection and extraction trenches must be sloped at a minimum of one-sixteenth inch per foot to a low point to facilitate water collection. If wells are utilized, well design will incorporate vapor extraction and or injection and water removal.

2. Soil Vapor Collection Piping and Associated Mechanical Equipment - The soil vapor collection piping shall include perforated and/or slotted pipe as well a solid pipe used for the purpose of collection and conveyance of soil vapors from a single source. Associated mechanical equipment shall include fittings, connections, pipe anchors, and accessories to this component of the SVE system. Collection pipes are typically combined at laterals and at a single or series of manifold pipes.

3. Soil Vapor Lateral Piping, Header Piping and Associated Mechanical Equipment - Soil vapor header piping shall consist of solid pipe used for the collection of soil vapors from multiple sources. The lateral and header piping shall convey soil vapors to the vapor treatment unit. Lateral and header piping shall also include injection wells and associated piping if this option is proposed. Lateral piping typically connects a small group of SVE wells to header piping. The header pipe typically interfaces with blower(s), air-water separator(s), heat exchanger(s), and the vapor treatment unit. Associated mechanical equipment shall include fittings, connections, pipe anchors, and accessories to this component of the SVE system.

4. Air-Water Separator(s) - Air-Water separator(s) consist of a manufactured mechanical device designed to remove free moisture from the soil vapor stream prior to introduction into the vapor treatment unit. The air-water separator(s) shall provide for direct connections to the Wastewater Storage Tanks.

5. SVE System Blower(s) - The SVE system blower(s) consist of a manufactured mechanical device designed to draw air through the soil by means of the soil vapor collection piping to aid in the removal of volatile organics.

6. SVE System Heat Exchanger(s) (Optional) - The SVE heat exchanger(s) consist of a manufactured unit designed to lower the soil vapor temperature prior to introduction into the vapor treatment unit.

7. Vapor Treatment Unit(s) - The vapor treatment unit shall consist of a manufactured unit designed to remove volatile organics from the soil vapor

stream. The vapor treatment unit can discharge treated soil vapors directly into the atmosphere or convey soil vapors to a reinjection system if this option is proposed.

8. Instrumentation and Controls - Instrumentation and controls shall include pressure gauges, vacuum gauges, flow meters, shutoff valves, control valves, sample ports, and associated mechanical and electrical equipment designed to monitor and control the SVE system operation.

9. Performance requirements for the SVE system are based on achievement of cleanup standards as defined in the Consent Decree for vapor, soils, and shallow groundwater. SVE system performance and cleanup criteria are described in Specification 13210 - SITE OPERATIONS AND MAINTENANCE, Part 3.12.

1.05 SUBMITTALS

A. General

1. The Contractor shall deliver submittals in accordance with the requirements of Section 01300 - SUBMITTALS.

B. SVE System Final Design

1. The final design of the SVE system as described in Section 1.04A shall include Contractor-generated construction drawings detailing the site layout and location of all system components. The Contractor shall include plans, details, sections charts, and tables as necessary to sufficiently describe the SVE system for construction. A base map of the site is available (DWG or DXF format). Construction drawings shall be dimensioned and drawn to scale. The SVE system final design shall include construction specifications in the Construction Specifications Institute (CSI) format. The SVE system final design drawings shall be dimensioned and to scale.

2. The Contractor shall provide his calculations supporting the SVE system design.

3. The initial SVE final design submittal will be reviewed by the Trustees and U.S. EPA prior to acceptance in accordance with Section 01300 - SUBMITTALS. The Contractor should anticipate comments and one major revision to the final design.

C. Shop Drawings

1. Shop drawings for SVE system or subsystem components shall include material callouts, connection details, and dimensions.

2. Shop drawings shall be submitted prior to fabrication of system components in accordance with the requirements of Section 01300 - SUBMITTALS.

D. Materials and Equipment Certifications

1. Materials and Equipment Certifications include manufacturer's descriptive literature and specifications covering products and components of the proposed SVE system.

2. Materials and Equipment Certifications shall be submitted prior to installation in accordance with the requirements of Section 01300 - SUBMITTALS.

1.06 QUALITY ASSURANCE

A. The Contractor shall assure quality through implementation of a Construction Quality Control (CQC) Plan. The requirements of the CQC Plan are defined in Section 01400 - CONSTRUCTION QUALITY CONTROL.

1.07 DELIVERY, STORAGE AND HANDLING

A. Transport and handle SVE system components and products in a manner recommended by the respective manufacturers of such to prevent damage or defects.

B. Store SVE system components and products in accordance with manufacturer's recommendations to prevent damage. Exercise such care in storage of other specified products as recommended by the respective manufacturers.

PART 2 - PRODUCTS

2.01 SVE SYSTEM GENERAL REQUIREMENTS

A. Soil Vapor Collection Piping, Lateral Piping, Header Piping and Associated Mechanical Equipment:

1. The soil vapor collection piping, lateral piping, header piping, and associated mechanical equipment shall be designed and constructed to exhibit the following characteristics:

a. Strength characteristics shall be consistent with the intended use. Pipes shall have the necessary strength to sustain the design pressure and vacuum loads with a factor of safety.

b. Piping and accessories shall exhibit the following durability characteristics: moisture resistance, temperature resistance, corrosion resistance, chemical resistance, and weather resistance.

These characteristics shall be exhibited to the extent necessary to be consistent with their intended use as part of the SVE system. Piping layout and design shall also maintain dimensional stability throughout environmental changes.

c. Piping and connections shall be air tight. Vacuum lines shall not draw air from the surrounding atmosphere (unless specifically designed for this purpose during operation) and pressure lines shall not leak or "bleed off" any portion of the collected soil vapor stream during system operation. Piping shall be pressure tested by manufacturer's recommended procedures prior to being put into service.

d. Piping shall exhibit the following measurable characteristics: levelness, plumbness, and alignment to slope as defined in the construction drawings. Dimensional tolerances shall be established in the construction specifications which shall take into account the materials proposed for SVE system piping.

e. Piping shall exhibit the following service characteristics: repairability, interchangeablility, accessibility, replaceability. Where possible, piping shall be adaptable to provide for alteration and/or modification. The service frequency shall be minimized for the life cycle of the project.

f. Each soil vapor collection pipe and header pipe shall be fitted with a sample port to allow for individual or collective sampling of soil vapors.

B. Air-Water Separator(s)

1. The air-water separator(s) shall be designed and constructed to exhibit the following functional characteristics:

a. The air-water separator(s) shall be a manufactured unit designed and constructed to remove free moisture from the vapor stream. The separator shall have sufficient capacity to handle removal of free water from the vapor stream at the anticipated flow rates with additional capacity to deal with variations in actual conditions.

b. The air-water separator(s) shall remove free water from the vapor stream to the extent necessary to avoid loading the vapor treatment unit with moisture at the expense of treatment capacity or system efficiency.

c. The air-water separator(s) shall be designed to allow for direct connection to wastewater storage tank T1. Connections and design of the air-water separator(s) to the tank shall be such that the transfer of collected water is automatic with little or no operator input.

The water transfer line between the SVE system and Tank T1 shall be a dual-containment pipeline. Provisions shall be made to monitor for leakage from the primary carrier pipe. Any leakage in the primary carrier pipe shall be reported to the Engineer. The Contractor shall make immediate repair or replacement of the leaky primary carrier pipe.

C. SVE System Blower(s)

1. The SVE system blower(s) shall be designed and constructed to exhibit the following functional characteristics:

a. The SVE system blower(s) shall be a manufactured unit designed and constructed to draw air through the collection, lateral, and header piping for the purpose of aiding in soil vapor extraction.

b. The SVE system blower(s) shall be sized to produce the design flow rates with excess capacity to afford flexibility of operation and adjustments to changing conditions.

c. The SVE system blower(s) shall be constructed from interchangeable parts to afford ease of maintenance and minimize operational costs.

d. Blowers shall be provided with safety interlocks to assure safe operation.

D. SVE System Heat Exchanger(s) (Optional)

1. The SVE system heat exchangers shall be designed and constructed to exhibit the following functional characteristics:

    a. Each SVE system heat exchanger shall be a manufactured unit designed to reduce the temperature of the soil vapor stream prior to introduction into the vapor treatment unit. The size of the heat exchanger and the total reduction in soil vapor stream temperature shall be consistent with the requirements of the vapor treatment unit and dependent on the incoming soil vapor temperature.

    b. The SVE system heat exchanger(s) shall be constructed from interchangeable parts to afford ease of maintenance and minimize operational costs.

    c. The SVE system heat exchanger(s) are an optional component of the SVE system to be utilized only if required.

E. Vapor Treatment Unit

1. The Contractor shall provide vapor treatment for the SVE vapor emission to meet the emissions limits described herein. The treatment unit may be one or a combination of thermal (flare), catalytic oxidation or activated carbon. The SVE system vapor treatment unit shall be designed and constructed to exhibit the following functional characteristics:

    a. The vapor treatment unit shall be a manufactured unit of sufficient capacity to remove VOCs from the soil vapor stream during SVE system operation.

    b. The vapor treatment unit shall be constructed from interchangeable parts to afford ease of maintenance and minimize operational costs. The Contractor shall repair or replace immediately any defective exhausted components. The SVE system shall continue to operate unless the untreated vapor exceeds the emission limits.

    c. Discharge from the vapor treatment unit shall cause no exceedance of National Ambient Air Quality Standards nor exceed the 3 pounds per hour Total VOC's emission rate thresholds established by the State of Indiana which would require a permit equivalence. Monitoring of vapor emissions shall be in accordance with the Air Monitoring Plan.

d. The Contractor shall provide assurances that the SVE system vapor treatment unit will not produce emissions causing excessive human health risks to onsite workers.

2. It is anticipated that a thermal treatment system using direct combustion with a supplemental fuel source shall be necessary to provide cost-effective removal of VOC's to meet the emissions limitation. The Contractor shall independently evaluate the appropriate vapor treatment system in the SVE design.

   To prevent unnecessary disruptions in the operation of a thermal vapor treatment unit from excessive VOC emissions or other failure, additional measures to be performed by the Contractor shall include:

   1. Routine preventative maintenance on all Air Pollution Control Devices APCD).

   2. Increase thermal destruction efficiency by raising the operating temperature.

   3. Increase thermal destruction efficiency by lowering the SVE system vapor treatment unit effluent volumetric flow.

      This can be done by lowering the overall volumetric flow or by isolating part or parts of the SVE system vapor treatment unit. For example, extracting soil vapor from less wells or trenches.

   4. Increase thermal destruction efficiency by improved mixing of fuel, SVE system vapor treatment unit effluent gas and combustion air. This can be done by increasing mixing turbulence to obtain a more uniform flame temperature. This may include the use of refractory baffles, swirl-fired burners, or baffle plates.

   5. Increase thermal destruction efficiency by increasing the amount of oxygen to the combustion process. This can be done by increasing the amount of excess combustion (ambient) air.

   If necessary, control of SVE system vapor treatment unit effluent can also be improved with secondary combustion, catalytic oxidation, and/or carbon canisters. These measures should be considered by the Contractor once an estimated range of SVE system vapor treatment unit effluent VOC concentrations has been developed during start-up and initial operations.

3. The Contractor may combine the vapor emissions form the wastewater treatment system air stripper with the SVE system vapor emissions for the purposes of vapor treatment. This modification to the wastewater treatment system design shall be approved by the Engineer. Details of this design shall be submitted by the Contractor with the SVE System Final Design (second look).

F. Instrumentation and Controls

1. The SVE system instrumentation and controls shall be designed and constructed to provide the operator with information necessary to access SVE system performance. Controls shall provide the operator with the ability to "tune" the system and make adjustments to operational parameters. Wherever possible, SVE system instrumentation and controls should be centrally located for ease of use. Field-mounted instruments and controls shall be located and oriented for efficient access and operation.

2. The following is a partial list of suggested instrumentation necessary for proper SVE system operation. Additional instruments necessary for operation of specific equipment proposed for the SVE system shall be included in the Contractor's Bid.

a. Vacuum Gauges - Shall be installed at the following locations of the SVE system:

(1) Individual collection pipes or trenches (upstream of shut off valves)
(2) Collection pipe laterals (one each)

(3) Header pipes (upstream of makeup air ports)

The Contractor may use sleeve-type couplers on piping with removable vacuum gauges in place of permanent mounted gauges. This arrangement shall be leak-free and allow for quick connection of vacuum gauges at coupler locations.

b. Pressure Gauges - Shall be installed on the header pipes prior to introduction into the vapor treatment unit, and elsewhere on the system as deemed necessary for system operation. Pressure gauges may utilize the same portable arrangement described in 2.01 H. 2.a.

c. Flow Meters - Shall be installed on laterals and header pipes and upstream to and/or downstream of system components as deemed necessary for system operation.

d. Temperature Gauges - Shall be installed to provide the influent and effluent temperature of the soil vapor stream at the heat exchanger.

e. Provisions shall be made to allow for monitoring emissions from the vapor treatment unit.

f. Additional electrical instrumentation (i.e., amp meters and/or thermal switches for motors) shall be installed as necessary to assure safe operation and protection of SVE system components.

3. The following is a partial list of suggested controls necessary for proper operation of the SVE system. Additional controls necessary for operation of specific equipment proposed for the SVE system shall be included in the Contractor's Bid.

   a. Control/Shutoff Valves - Shall be installed on each collection pipe downstream of vacuum gauges to allow for adjustments of flow from specific areas and for isolation of areas for maintenance and repair. Additional valves shall be installed as necessary to isolate equipment during changeout and/or repairs.

   b. A control panel shall be installed which incorporates on/off switches and indicators for operation of all electrically powered components of the SVE system. The control panel shall integrate the SVE system components to provide "fail safe" operation and automatic shutdown of the SVE system if problems arise.

   c. The following is a partial list of conditions which may require SVE system shutdown. Deletions from this list or additional conditions may be appropriate based on the specific SVE system proposed.

      (1) Soil vapor temperature outside of the operating range of the vapor treatment unit (estimated at 150-180°F on the high range and 75-85°F on the low range). High temperature and low temperature vapor stream may be due to failure of the heat exchanger or air-water separator respectively.

      (2) High water level in the air-water separator indicating problems with liquid transfer.

      (3) High or low pressure conditions in the collection or header pipes.

(4) Power interruptions at the site.

(5) Shutdown of the soil vapor treatment unit.

4. An autodialer shall be installed as part of the SVE system instrumentation and controls. The autodialer shall be programmed to notify the system operator or backup operator by direct call or remote pager in the event of a system shutdown or emergency.

2.02 SOURCE QUALITY CONTROL

A. Source quality control shall be in accordance with the requirements of Section 01400 - CONSTRUCTION QUALITY CONTROL and Section 01300 - SUBMITTALS. Source quality control shall be assured through submission of manufacturer's documentation, certificates of conformance, and other appropriate documentation.

PART 3 - EXECUTION

3.01 WORK AREA LIMITS

A. The Contract Drawings define the work area limits for soil remediation. This includes excavation limits, SVE system soil remediation limits, and the SVE system support zone boundary.

1. The excavation limits are defined in Section 02200 - EARTHWORK. Excavated soils will be placed in a fill for SVE treatment. Section 02200 details the horizontal and vertical extents for excavation of contaminated soils.

2. The site remedial boundary, except for the southern concrete pad area, defines the horizontal extents of SVE soil remediation. The excavation area is not included in the SVE scope of work, although it is within the remedial boundary. This boundary also defines the limits of intrusive work permitted for installation of the SVE system trenches and/or wellpoints.

3. The vertical extent of SVE treatment must be 9 feet below existing ground surface.

4. SVE trenches and wellpoints shall not penetrate into the sand water bearing zone underlying the shallow till. The Contractor shall immediately notify the Engineer if the sand zone is encountered during construction of the SVE system. The maximum vertical depth for SVE trenches and/or wellpoints shall be 10 feet below existing ground surface.

5. The SVE system support zone is the area outside of the remedial boundary and extends to the perimeter fence. This area can be used if necessary for placement of mechanical or electrical equipment associated with or part of the SVE system.

6. The placement of SVE system equipment or aboveground piping in the SVE support zone shall not inhibit the use of any of the site entrance gates nor block access to any portion of the site.

3.02 GENERAL SYSTEM OPERATIONS

A. The SVE system shall be designed and constructed to afford flexibility in operation and maintenance. Wherever possible, interchangeable parts, industry standard materials and connections, and "off the shelf" products shall be used. The design of the SVE system shall be segmented to allow for isolation of portions of the system for operations and maintenance purposes.

B. The SVE system shall be operated continuously, 24 hours a day, 7 days a week, unless total shutdown occurs as described in Specification Section 2.01 H.3.C.

C. An operator shall be present onsite at a minimum (1) 8-hour shift per week to perform routine maintenance, inspections, testing, and monitoring as required by these specifications.

D. The Contractor shall designate a qualified system operator and backup operator that shall be approved by the Trustees. The operator and/or backup operator shall be available by direct communication or remote pager 24 hours a day in the event of a system shutdown or emergency.

E. SVE operations shall limit noise levels to 85 decibels or less as measured anywhere along the site fenceline.

F. The SVE operations shall be conducted consistent with the procedures in the Site O&M Manual as described in Section 13210 - SITE OPERATIONS AND MAINTENANCE, and Section 13200 - SVE SYSTEM OPERATIONS START-UP.

G. If the SVE system is shut down due to a combination of (a): the need to shut down the water treatment system and (b): exceedance of on-site water storage capacity, and the shutdown of the SVE system for that reason continues for more than 5 days in any one month or for more than an average of 3 days a month (using a rolling average and for this purpose an assumed SVE operation time of 1 year), then water generated by the SVE system will be disposed of off-site so as to allow resumption of SVE system operation.

3.03 EXAMINATION

A. Products and equipment of the SVE system shall be examined for damage or defects prior to installation. Defective or damaged products or equipment shall be returned to the supplier for replacement.

B. Examination of installation practices and completed work on the SVE system shall be in accordance with the provisions of Section 01400 - CONSTRUCTION QUALITY CONTROL and the associated Construction QC Plan.

3.04 PREPARATION

A. The Contractor shall prepare work areas prior to execution of work.

B. Preparation of mating surfaces and connections of SVE system components shall be in accordance with manufacturer's recommendations. Connections of dissimilar materials shall be made after appropriate preparation of each mating surface has been performed. Gaskets shall be installed where needed.

3.05 INSTALLATION

A. Installation of all SVE system products and components shall be in accordance with manufacturer's recommendations and industry standard practices.

B. SVE system products and components shall be installed as detailed in the approved Final Design of the SVE system.

3.06 FIELD QUALITY CONTROL

A. Field quality control shall be in accordance with the requirements of Section 01400 - CONSTRUCTION QUALITY CONTROL and the associated Construction QC Plan.

3.07 ADJUSTING AND CLEANING

A. Adjustments and cleaning of the SVE system shall be in accordance with the procedures identified in the Site O&M Manual and manufacturer's recommendations for system products and components.

3.08 PROTECTION

A. The SVE system components shall be designed and constructed to afford protection from the weather. Outdoor-mounted electronics and electrical devices shall be housed in appropriate NEMA rated enclosures. Product and equipment surfaces exposed to the elements shall also be appropriately protected.

B. The SVE system components shall be protected from normal work activities during construction and operation. This shall be achieved through strategic location of sensitive equipment away from high traffic areas.

END OF SECTION

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13110 - WASTEWATER TREATMENT SYSTEM

Rev. 3, 5/28/97

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section covers the requirements for the onsite wastewater treatment system. This system shall be used to treat wastewaters generated construction and operation phases of the project including during the excavation and SVE system operation. The treatment system consists of filtration, air stripping, and activated carbon adsorption. It is intended primarily for the removal of organic contaminants and suspended solids. The treatment system may include a chemical oxidation system for iron removal and an oil/water separator for removal of free oil and grease if needed based on performance of the wastewater treatment system. The chemical oxidation system is a contingency measure and is described in Section 13111 - CHEMICAL OXIDATION SYSTEM FOR IRON REMOVAL (Contingency Measure). The oil/water separator is a contingency measure and is described in Section 13112 - OIL/WATER SEPARATOR (Contingency Measure).

The wastewater treatment system process and instrumentation diagram is shown on the drawings.

1.02 RELATED SECTIONS

A. Section 13120 - STRUCTURES

B. Section 13210 - SITE OPERATIONS AND MAINTENANCE

C. Section 13050 - WASTEWATER STORAGE AND TRANSFER SYSTEMS

1.03 PERFORMANCE REQUIREMENTS

A. The filtration system shall be constructed to remove all solids greater than 10 microns. The filtration system shall be capable of achieving this performance at a flow rate of 50 gpm. All water shall pass through the filtration system prior to flowing into the carbon treatment units. The filtration system shall produce an effluent with less than 30 mg/l solids or IDEM discharge standards for solids, whichever is more stringent. The maximum pressure drop across the filtration system shall not exceed 20 psig. Contractor shall supply inlet raw wastewater to the treatment system, prescreened through a 100 micron filter. Contractor shall supply at least two filter packages consisting of two bag filters(50 and 25 micron) per filter package, plus at least two 10 micron cartridge filters, all sized for 50 gpm.

B. The air stripper system shall be a shallow tray type designed to strip a wastewater flowrate of 50 gpm with an ambient air stream of 900 cfm. The stripper shall be capable of reducing liquid phase methyl chloride to five (5) parts per billion (ppb). The system shall include dual 3 HP sump pumps and a minimum of six (6) shallow trays. All wetted parts of the feed pumps shall be of non-metallic construction.

Feed to the stripper shall be supplied by two (2) Vanton, or equal, water pumps. The pumps shall be able to handle solids loading expected in tank T2 (<100 micron), and each supply a constant flow of 50 gpm through the primary filters and to the air stripper unit.

C. The two (2) liquid phase granulated activated carbon(GAC) units shall contain 1,000 lbs. of granular activated carbon and be capable of treating 50 gpm each, while operating in series. Construction shall be steel. The carbon units shall be capable of treating the site wastewaters to achieve the IDEM effluent standards established for discharge on-site, when preceded by the air stripper. The liquid phase GAC units shall have a maximum operating pressure no less than 85 psi.

Computer simulations performed by Carbonair (New Hope, MN, (612) 544-2154), indicate that 0.25 pounds of carbon is needed to treat 1,000 gallons of stripped wastewater to proposed permit limits. The limiting compound by carbon usage rate was phenol. Raw wastewater sample results from the Phase II and Removal Action samples were the basis for the estimate.

D. The two (2) vapor phase carbon treatment units shall each contain 5,000 lbs. of granular activated carbon and be capable of treating 900 cfm in series. Construction shall be steel. The vapor phase GAC units shall treat the stripper off gases to below IDEM limits.

Computer simulations performed by Carbonair, New Hope, MN, indicate that 430 pounds of carbon is needed to treat 1 million cubic feet of stripper off gases. The limiting compound by carbon usage rate was 1, 2-Dichloroethene.

E. The entire wastewater treatment system shall be capable of maintaining operation while one adsorber is being serviced. The entire system shall be capable of operating at all pressure ranges required for continued system operation, over a temperature range from 55 to 140°F, while flowrate is 50 gpm. The system shall also be capable of intermittent operation, or 24 hour continuous treatment of the raw wastewater.

F. The Contractor shall provide all appurtenances and controls for the system that are required for proper and safe operation, in addition to those shown in the process drawings. The equipment and controls shall meet the product requirements of these specifications.

G. The Contractor shall provide bubble diffusers for storage tank T2. The aerators shall be submerged and shall supply at least 0.14 mg/l oxygen to the wastewater per mg/l of iron oxidized. The aerators shall be installed on the southern half of the tank bottom in a spoke and hub pattern.

1.04 SUBMITTALS

A. The following shall be submitted in accordance with Section 01300.

1. Manufacturer's catalog data for all system components or equivalents, composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope shall be submitted to the Enviro-Chem Trustees Engineer for approval prior to installation.

2. Detail drawings shall be submitted to show equipment and piping layouts, location of vessels, pumps, piping connections and support points within the Wastewater Treatment Building.

3. Upon completion of installation and testing, test reports shall be submitted for all field tests conducted to prove compliance with the performance requirements. System start-up and testing is described in Specification Section 13210 - SITE OPERATIONS AND MAINTENANCE, Part 3.06.

PART 2 - PRODUCTS

2.01 WASTEWATER TREATMENT SYSTEM

A. The Contractor shall supply a raw wastewater treatment system which consists of the following elements:

1. One (1) Carbonair Model STAT-180 shallow tray air stripper unit, with associated single blower and dual sump pumps, all located on a common skid with remotely mounted control panel; or its approved equal.

2. Two (2) Carbonair Model GPC-48 vapor phase granular activated carbon vessels, or their approved performance equivalent.

The Contractor may also propose to treat the stripper vapor phase discharge in combination with the SVE System as described in Specification Section 13100 - SOIL VAPOR EXTRACTION SYSTEM, Part 2.01 E.

3. Two (2) Carbonair Model PC-7 liquid phase granular activated carbon vessels(steel construction), or their approved performance equivalent.

4. One (1) Carbonair 12kW in-line duct heater designed for 900 cfm flowrate and a 100 °F effluent temperature, or its approved performance equivalent.

5. Three (3) Pipe and Valve Assemblies or their approved performance equivalent as shown on the Drawings.

6. Two (2) Vanton model CG500 non-metallic pumps, TEFC, for 50 gpm @ 140' tdh or their approved performance equivalent.

7. Check Valves - PVC check valves sized for 2 inch pipes; True Check model from Hayward Industrial Products, or their approved performance equivalent.

8. Piping - PVC construction, 2 inch schedule 80 for liquid service, 8 inch for vapor service, or their approved performance equivalent.

9. Ball Valves - Hayward Ind. Products true union type, PVC construction, sized for 2 inch piping, or their approved performance equivalent.

10. Sample Valves - Hayward Ind. Products, PVC constructed, 1/2 inch true union ball valves, or their approved performance equivalent.

11. Solenoid Valves - Asco model "Red Hat" with 2 inch connections and explosionproof enclosure; catalog number 8210B56, or their approved performance equivalent. See electrical specifications for voltage.

12. Differential Pressure Valves - Hayward Ind. Products 1/4 inch true union ball valves, PVC construction, or their approved performance equivalent.

13. Bag Filters - Four (4): 2 each 50 micron and 2 each 25 micron, all FSI model FSPN-85, with 2 inch pipe connections, or their approved performance equivalent. Filters shall have floor supports with adjustable height mounting legs, all shall have 3/4 inch drain connections.

14. Flow Totalizer/Indicators - BadgerMeter Model M-70 with optional totalizer, or their approved performance equivalent.

15. Pressure Indicators - Marsh gauges; 3 ½ inch dial size with 0 to 200 psig readout, 1/4 inch male bottom connection, and plain case or their approved performance equivalent.

16. Globe Valve - One (1) Asahi globe flow-control valve with 2 inch socket fittings, or its approved performance equivalent.

17. Flow Control Valve - Flo-Controllet flow control valve, HDPE construction, sized for 2 inch piping, or its approved performance equivalent.

18. Cartridge Filters - Two (2) 10 micron cartridge filters as manufactured by Fulflo Water Filters, sized for 50 gpm flow and 2 inch connectors, or their approved performance equivalent.

19. Three-Way Valves - Hayward PVC constructed true union 3-way ball valves, sized for 2 inch piping, flange connectors with gaskets, or their approved performance equivalent.

20. Sump Pump - One (1) submersible sump pump, 1/2 HP with appropriate length hose to reach tank T2, or its approved performance equivalent. Sump system shall be built on site to meet site requirements.

21. Flexible Ducting - Round ducting, 8 inch, heavy duty rated nitrile coated nylon, type 351 as supplied by Flexmaster, or its approved performance equivalent.

22. Vapor Phase Piping - 8 inch PVC ducting by Spears, or approved performance equivalent.

23. Duct Heater - Carbonair 12 kW in line duct heater, or approved performance equivalent. Automatic temperature controls and connections to PLC to be supplied by heater vendor and shall meet all applicable electrical specifications.

24. Butterfly Valves - Asahi brand, Onmi series for 8 inch piping, flanged, with viton seals and gaskets, designed for vapor phase use, or their approved performance equivalent.

25. Quick connect/disconnect couplings - PT brand adaptors and couplers sized for 2 inch fittings and pipe connection, or their approved performance equivalent.

26. Quick connect/disconnect couplings - PT brand adaptors and couplers sized for 8 inch fittings and pipe connection, or their approved performance equivalent.

27. Vent - One (1) roof vent, fabricated on site with flashing and caulking as required. Vent cap, bird screen and rain hood included and fabricated on site.

28. Pipe supports - B-Line® channel system or equivalent shall be anchored to building structure (walls or trusses) as required to support equipment and piping loads. Anchoring type and method to be determined by contractor prior to installation. Located as depicted on drawings.

29. Pipe clamps, hanger anchors and other pipe appurtenances - To be determined by contractor. Must be appropriate for proper mating with pipe supports. Size and material to be determined by contractor, and must be appropriate for anticipated loadings.

30. Pressure hose and barbs - To be determined by contractor, and shall be designed for high pressure use of 150% of maximum anticipated pressure.

31. Hard piping components - All tees, elbows, reducers, plugs, adapters, and other hard piping components shall be supplied by contractor and shall be in accordance with ASTM D 1784.

Note: For all component counts not specified above, please refer to Process and Instrumentation drawings.

The primary filter and both GAC systems shall be configured to operate in series so that one treatment unit will be the primary adsorber (lead) while the other treatment unit will act as a backup (lag). In both systems, the piping shall enable one unit to be isolated for disconnection and change-out while maintaining operation through the other.

B. The Contractor shall provide a filtration system to remove suspended solids from the wastewater prior to its treatment by carbon adsorption.

1. The filtration unit shall be four (4) dual bag filters--paired and set in series, followed after the air stripper by a set of two (2) cartridge filter type media.

   Twenty cartridge filters and bag filters shall be provided to remove suspended solids and maintain sufficient flow to the carbon treatment units. Cartridge and bag cleaning may be performed onsite as needed. Twenty spare cartridges and bags shall be provided on-site and installed so as not to disrupt treatment system operations during cleaning of spent media. All removed solids and wastewaters generated by cleaning shall be managed in accordance with Section 02080-REMEDIAL ACTION GENERATED WASTES.

2. Filtration system components, including vessels, piping, cartridges and filter media shall be chemically compatible with site wastewaters. The system components shall be corrosion resistant, and located as shown in the process and instrumentation diagrams.

C. Wastewater Treatment Feed Pumps (P100 A & B).

1. The wastewater treatment pumps (P100 A & B) shall be non-metallic construction pumps: Model CG500 as manufactured by Vanton, or equal.

   Each pump shall meet the following design requirements and functional characteristics:

   a. 50 gpm @ 140 Ft TDH
   b. 2-inch intake - flanged
   c. 2-inch discharge - flanged
   d. 3450 RPM operating speed
   e. 460 Volt 3-phase power
   f. 10 HP rating
   g. Non-metallic wetted parts
   h. Fully-enclosed explosion-proof motor
   i. No linings or laminations

   The pumps shall be housed within the water treatment building, with influent pipes running underground into Building C, Wastewater Treatment Building.

2. The Contractor shall provide an additional spare pump for the wastewater treatment pumps(P100 A/B). The piping connections to the wastewater treatment pumps shall be able to be quickly disconnected.

3. Control switches shall be installed to shut down the wastewater pumps if the following condition is met:

   a. Water level in storage Tank T1 or T2 drops to 12 inches above the floor drain.

   b. Water level in storage Tank T3 rises to within 12 inches of top of the sidewall rail.

D. Wastewater Treatment Shallow Tray Air Stripper.

1. The wastewater treatment air stripper shall be a shallow tray design; Model: STAT-180 or approved equal as manufactured by:

   Carbonair
   2731 Nevada Avenue North
   New Hope, MN 55369
   (612) 544-2154

   This stripper shall meet the following design requirements and functional characteristics:

   a. 50 gpm minimum operational liquid flowrate
   b. 900 cfm minimum operational vapor flowrate
   c. 6 inch inlet and discharge ports - vapor side
   d. 2 inch inlet and discharge ports - liquid side
   e. 460 Volt 3-phase power
   f. Dual sump pumps with controls
   g. 3 Horsepower sump pump rating
   h. 12 Horsepower blower rating
   i. 15 kW duct heater
   j. All components mounted on a common skid
   k. All components explosion proof

   The stripper system shall be housed within Building C, Wastewater Treatment Building, in accordance with process diagrams.

3. Control switches shall be installed to shut down the wastewater stripper if the following condition is met:

   a. Water level in stripper sump drops to 1 inch above the floor drain.

   b. Water pressure in the carbon units downstream rises to level set by manufacturer.

   c. Low air pressure in air stripper.

E. Backwash Pump.

1. One portable backwash pump capable of 140 gpm and 85 psi, with 2 inch connections and cable and plug connector. Control switches as itemized on the process and instrumentation drawings. All appropriate controls for safe operation, including control of flowrate and pressure indicator shall be supplied by contractor. Supply water shall be from tank T3 and effluent

backwash shall be routed to tank T1. Contractor shall be responsible for supplying all necessary appurtenances, including, but not limited to: adequate lengths of flexible tubing, couplings, and power.

F. Sump Pumps.

1. One 1/2 hp, 115V sump pump with level controls for installation in the wastewater treatment system building sump area.

G. Meters/Gauges.

All electrical meters and gauges shall be rated for use in Class I Division I areas.

1. One pressure gauge(range 0 to 50 psi) shall be installed on the discharge side of the air stripper, and prior to the vapor carbon units; another pressure gauge(range 0 to 50 psi) shall be installed between the two vapor carbon units; and one pressure gauge(range 0 to 50 psi) shall be installed downstream of the final vapor phase carbon adsorber unit. Control switches as itemized on the process and instrumentation drawings.

2. One temperature gauge(0 to 150°F) shall be installed on each of the vapor phase carbon units. Control switches as itemized on the process and instrumentation drawings.

3. One flow meter (magnetic or paddle wheel type, 0 to 150 gpm) with totalizer and flow indicator shall be installed on the wastewater pump (P100A&B) discharge pipe. A second flow meter and totalizer shall be installed downstream of the liquid phase adsorbers. These flow meters shall include a digital totalizer. The totalizer shall be located at a convenient location for monitoring by onsite personnel.

4. Pressure gauges(range 0 to 50 psi) shall be installed on the bag filters(inlet side), and upstream of the cartridge filter units. Control switches as itemized on the process and instrumentation drawings.

5. One pressure gauge(range 0 to 50 psi) shall be installed on the discharge side of the air stripper sump pumps, and prior to the liquid carbon units; another pressure gauge(range 0 to 50 psi) shall be installed between the two liquid carbon units; and one pressure gauge(range 0 to 50 psi) shall be installed downstream of the final liquid phase carbon adsorber unit. Control switches as itemized on the process and instrumentation drawings.

H. Bubble Diffuser

1. The Contractor shall provide a bubble diffuser secured to the wall or floor of storage tank T2. The aerator shall be designed to maintain sufficient pressure on headers to eliminate clogging of diffusers. Oxygen transfer rate shall be at least 0.9 kg oxygen per kilowatt hour. A check valve shall be included in the over the wall piping from the air blower to the diffuser to avoid water flow to the blower.

I. Miscellaneous Instrumentation.

1. Instrumentation not otherwise specified herein, but shown on the process and instrumentation drawings shall be supplied by the Contractor and installed per the drawings for proper operation given the process dynamics as described in the specifications package. All instrumentation supplied shall be new and in proper working order. Damaged or malfunctioning equipment will be replaced by the Contractor at the Contractors expense, after approval by the Engineer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for installing the systems within the Wastewater Treatment Building at the location shown on the Drawings. Pumps, piping and connection requirements for the wastewater storage system are provided in Specification Section 13050. Process and instrumentation requirements are indicated on the Drawings. All instrumentation and manually controlled appurtenances shall be installed in locations easily accessible by on-site personnel.

B. All piping and ductwork shall be clearly labeled with pipe markers clearly showing the following:

Pipe flow direction (with arrows),
Service/contents (liquid or vapor), and
Content name (3/4 inch all capital lettering, IE. FEED WATER).

The pipe markers shall be color coded by Contractor, for quick identification.

3.02 SAMPLING AND ANALYSIS

A. Sampling and analysis of the effluent from the system shall be performed by the Contractor in accordance with Section 01392 - ENVIRONMENTAL SAMPLING AND QUALITY ASSURANCE and Section 13210 - SITE OPERATIONS AND

MAINTENANCE. Sampling points shall be located as shown in the wastewater treatment system process drawings.

3.03 WASTE DISPOSAL

A. The Contractor shall be responsible for carbon acceptance testing and disposing and/or reactivation of spent carbon. Carbon shall be considered spent whenever breakthrough is detected from the lead treatment unit at the concentrations established during operations start-up.

3.04 OPERATIONS

A. System startup and operations are described in Specification Section 13210 - SITE OPERATIONS AND MAINTENANCE, Part 3.06.

END OF SECTION

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13111 - CHEMICAL OXIDATION SYSTEM FOR IRON REMOVAL (CONTINGENCY MEASURE)

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section covers the requirements for the chemical oxidation system contingency measure for iron removal. The system will act as a back-up if needed, to the primary aeration system provided as part of the wastewater treatment system as described in Section 13110. The chemical oxidation system is a contingency that will be required only if directed by the Engineer. The system will not be constructed initially as part of the wastewater treatment system. If implemented, the chemical oxidation system shall be used to remove iron from wastewaters to eliminate the possibility of iron fouling in carbon adsorbers or other integral treatment units. An oxidizing agent shall be added to the wastewater which will cause iron precipitation.

1.02 RELATED SECTIONS

A. Section 13110 - WASTEWATER TREATMENT SYSTEM.

B. Section 13210 - SITE OPERATIONS AND MAINTENANCE.

1.03 PERFORMANCE REQUIREMENTS

A. The chemical oxidation system shall include a chemical delivery system designed for delivery of an optimum dose of oxidizing agent with chemically compatible pumping, piping and chemical storage equipment. The Contractor shall perform bench-scale and other testing as needed to determine the optimum oxidizing agent and its dosage.

B. The oxidation system shall include equipment for rapid and complete mixing of wastewater and oxidizing agent.

C. The wastewater and oxidizing agent mixture shall be discharged into wastewater storage tank T1 on the upstream side of the tank baffle. Either a separate reaction tank or in-line mixing device is anticipated.

D. The oxidation system shall maintain an effluent with a total iron level less than 1.0 mg/l or IDEM discharge standards, whichever is more stringent. The effluent iron criteria shall be measured at the inlet to the wastewater treatment system filtration unit.

1.04 SUBMITTALS

A. The following shall be submitted:

1. Manufacturer's catalog data for all system components, composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope shall be submitted to the Enviro-Chem Trustees Engineer for approval prior to installation.

2. Detail drawings shall be submitted to show piping layouts, location of vessels, pumps, piping connections and support points for the system.

3. Upon completion of installation and testing, test reports shall be submitted for all field tests conducted to prove compliance with the performance requirements.

PART 2 - PRODUCTS

2.01

A. The contractor shall supply chemically compatible pumps, piping and storage capacity for the chosen oxidizing agent.

B. Solids collection and dewatering equipment shall be provided for storage tank T1 by the Contractor, based on expected amounts of sludge generated. Piping and pumping requirements for returning wastewater to the treatment train shall be included. The solids collection equipment for storage tank T1 shall be designed to prevent particles from being resuspended and shall be easy to clean and maintain. Dewatered solids will be disposed as described in Section 02080 - REMEDIAL ACTION GENERATED WASTES.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The contractor shall be responsible for installing the system in a manner compatible with the wastewater storage tanks and other operating systems within the support zone.

3.02 SAMPLING AND ANALYSIS

A. Sampling and analysis of the effluent wastewater treatment system shall be performed by the Contractor in accordance with Section 01392 - ENVIRONMENTAL SAMPLING AND QUALITY ASSURANCE and Section 13210 - SITE OPERATIONS AND MAINTENANCE. No sampling of the chemical oxidation system effluent is anticipated.

3.03 OPERATIONS

A. General wastewater treatment system startup and operations are described in Section 13210 - SITE OPERATIONS AND MAINTENANCE, Part 3.06. These requirements shall be followed as applicable and as directed by the Engineer for the chemical oxidation system.

END OF SECTION

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13112 - OIL/WATER SEPARATOR (CONTINGENCY MEASURE)

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section covers the requirements for the oil/water separator for removal of free oil and grease (FOG). The system will act as part of the wastewater treatment system described in Section 13110, if needed. The oil/water separator is a contingency that will be required only if directed by the Engineer. The system will not be constructed initially as part of the wastewater treatment system. If implemented, the oil/water separator shall be used to remove FOG from wastewaters to eliminate the possibility of FOG fouling in the carbon adsorbers or other integral treatment units.

1.02 RELATED SECTIONS

A. Section 13110 - WASTEWATER TREATMENT SYSTEM

B. Section 13210 - SITE OPERATIONS AND MAINTENANCE

1.03 PERFORMANCE REQUIREMENTS

A. The Contractor shall provide an oil/water separator with coalescing plates. The system shall be capable of treating up to 50 gpm of wastewater. The oil water separator shall be designed to remove free oil and grease (FOG) from an influent stream to achieve an effluent containing less than 10 mg/l of oil droplets larger than 20 microns or meet IDEM effluent standards for oil and grease, whichever is more stringent. The expected characteristics of wastewater and FOG are as follows:

- Groundwater temperature range, 50-70°F;
- Groundwater specific gravity, 1.0; and
- Oil specific gravity, less than or equal to 0.9.

1.04 SUBMITTALS

A. The following shall be submitted:

1. Manufacturer's catalog data for all system components, composed of catalog cuts, brochures, circulars, specifications and product data, and printed

information in sufficient detail and scope shall be submitted to the Enviro-Chem Trustees Engineer for approval prior to installation.

2. Detail drawings shall be submitted to show piping layouts, location of vessels, pumps, piping connections and support points for the system.

3. Upon completion of installation and testing, test reports shall be submitted for all field tests conducted to prove compliance with the performance requirements.

PART 2 - PRODUCTS

2.01

A. The Contractor shall provide a coalescing oil/water separator sized and designed to remove free oil from a wastewater stream and produce an effluent containing less than 10 mg/l of oil droplets larger than 20 microns. Nominal separator size anticipated is 500 gallons. The unit shall contain it's own pumping system for conveyance of effluent. The separator shall be constructed of premium grade materials with coalescing media, interior baffles and removable cover. The unit shall contain non-clogging inlet nozzle. Coalescing media shall be easy to clean. An adjustable oil skimmer and weir and a clean water chamber shall be included. The separator shall contain a stand to elevate the unit at a height suitable for locating a 55-gallon barrel under the stand for oil collection. All removed oils and solids generated by the separator shall be managed in accordance with Section 02080 - REMEDIAL ACTION GENERATED WASTES.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The contractor shall be responsible for installing the system in a manner compatible with the wastewater treatment system and other operating systems within the support zone.

3.02 SAMPLING AND ANALYSIS

A. Sampling and analysis of the effluent wastewater treatment system shall be performed by the Contractor in accordance with Section 01392 - ENVIRONMENTAL SAMPLING AND QUALITY ASSURANCE and Section 13210 - SITE OPERATIONS AND MAINTENANCE. No sampling of the oil/water separator effluent is anticipated other than that required by the Contractor to meet performance requirements.

3.03 OPERATIONS

A. General wastewater treatment system startup and operations are described in Section 13210 - SITE OPERATIONS AND MAINTENANCE, Part 3.06. These requirements shall be followed as applicable and as directed by the Engineer for the oil/water separator.

END OF SECTION

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13120 - STRUCTURES

(Rev. 1, 2/7/97)

PART 1 - GENERAL

1.01 SUMMARY

A. This section provides requirements for construction of structure(s) in the support zone as shown in the contract drawings.

B. The structure(s) are defined as follows:

1. Building A, Optional Soil Vapor Extraction System building.
2. Building B, Optional Vapor Treatment Unit(s) building.
3. Building C, Wastewater Treatment building.
4. Building D, Wastewater Transfer building.
5. Building E, Blower Shed.

C. The Contractor shall evaluate the need for Building(s) A and/or B based on the specific SVE System and vapor treatment unit(s) proposed. The Contractor may propose trailer-mounted and/or permanent structures to meet these needs. If the Contractor chooses to propose permanent structures to accommodate the SVE System and/or Vapor Treatment Unit(s), the materials and type of construction identified in this Specification shall apply.

D. Buildings C and D (Wastewater Treatment and Transfer Buildings) shall be constructed in accordance with this Specification and the contract drawings.

E. Building E shall be a premanufactured building placed on a minimum 4-inch thick concrete slab.

1.02 SECTION INCLUDES

A. The construction of concrete foundations, slabs, and footings as specified herein.

B. The construction of one-story light gauge metal framed buildings as specified herein.

C. Installation of a trussed roof system and shingle roof, vinyl siding, gable trim, painted aluminum gutters, downspouts, and gable-end vents as shown on the drawings and as specified herein.

D. Construction of light gauge metal framed partition walls with gypsum wallboard covering, and installation of doors and windows as specified herein and as shown on the drawings.

E. Installation of electrical system, light fixtures, and devices.

F. Installation of heating systems as specified herein.

G. Construction of sidewalks, landings, and aprons as shown on the contract drawings and specified herein.

1.03 RELATED SECTIONS

A. Section 03200 - CONCRETE REINFORCEMENT.

B. Section 03300 - CAST-IN-PLACE CONCRETE.

C. Section 03350 - CONCRETE FINISHES.

D. Section 01390 - HEALTH AND SAFETY.

1.04 REFERENCES

A. BOCA National Building Code 1993, Twelfth Edition.

B. American Architecture Manufacturer's Association (AAMA) 1402-86 Standard Specifications for Aluminum Siding, Soffit, and Facia.

C. American Society for Testing Materials (ASTM).

1. A185-90a - Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

2. C36-92 - Specification for Gypsum Wallboard.

3. C90-92a - Specification for Load Bearing Concrete Masonry Units.

4. C94-92 - Specification for Ready-Mixed Concrete.

5. C475-89 - Specification for Joint Compound and Joint Tape for finishing Gypsum Wallboard.

6. C476-91 - Specification for Grout for Masonry.

7. D225-86 - Specification for Asphalt Shingles Surfaced with Mineral Granules.

1.05 SUBMITTALS

A. General.

1. The Contractor shall deliver submittals in accordance with the requirements of this part and Section 01300 - SUBMITTALS.

B. Plans

1. The Contractor shall submit detailed plans for the SVE System building and the Vapor Treatment Unit(s) building if permanent structures are proposed.

2. The plans shall be submitted two weeks prior to the start of construction for review and comment.

3. The plans shall conform to the Specifications of this section.

C. Product Data

1. The Contractor shall submit product data and or samples of the following materials prior to installation:

a. Roof shingles
b. Vinyl siding
c. Doors
d. Windows
e. Soffit and facia
f. Floor tile
g. Interior paint
h. Heating system

1.06 DELIVERY STORAGE AND HANDLING

A. Materials and equipment shall be shipped and stored in the original manufacturers containers until installation.

B. Materials shall be stored in a safe area, away from traffic and protected from weather.

C. Extreme care shall be used in unloading materials to prevent damage.

D. All unguarded materials shall be secured from theft.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S AND MATERIALS

A. Concrete Construction.

1. Footings and Slabs shall conform with the requirements of Section 03300 - CAST-IN-PLACE CONCRETE.

2. Reinforcement shall conform with the requirements of Section 03200 - CONCRETE REINFORCEMENT.

B. Masonry Work.

1. Concrete Masonry Units (Hollow).

(a) Provide normal weight hollow load-bearing masonry units complying with ASTM C90, Grade N, "Natural Gray" in color, 8" x 8" x 16" and 6" x 8" x 16" inch sizes.

(b) Provide proper shapes for corners, stretchers, etc. Damaged, cracked, or uncured concrete blocks shall not be acceptable. Care shall be taken so that the concrete blocks will not be chipped, cracked, or broken during delivery, handling, and installation.

2. Mortar.

(a) Mortar shall comply with ASTM C270, Type M, and shall consist of Portland cement Type I combined with hydrated lime or lime putty and natural or manufactured sand. The color should be natural. No admixtures shall be used unless authorized by the Engineer.

C. Light Gauge Steel Framing.

1. The light gauge steel framing members shall be cold formed structural steel shapes designed for use in building framework. All structural members shall be in accordance with the American Iron and Steel Institute (AISI)

Specification for the Design of Cold Formed Steel Structural Members, 1986 Edition. All framing members shall be formed from corrosion resistant steel, corresponding to the requirements of ASTM A446, with minimum yield strengths as follows:

a. 40 KSI for PCS style studs.

b. 33 KSI for CWS style studs; CWT and UDLT style tracks.

D. Lumber.

1. General.

a. Lumber for use as structural components shall bear the official grade mark of the inspection bureau or association under whose rules it is graded, or in lieu thereof each shipment shall be accompanied by a "Certificate of Inspection" issued by such bureau or association. Lumber shall be surfaced four sides tongued and grooved, ship-lap or worked to such patterns as are indicated on the drawings or specified. Finish sizes shall conform to yard size standards of American Lumber Standards SPR-R16-39.

b. The moisture content of lumber shall conform to the seasoning requirements of the grading rules of the inspection bureau or association under which it is purchased.

2. Decking.

a. The roof deck material shall be ½-inch thick tongue and groove CDX plywood securely nailed or screwed to the trusses.

b. The plywood deck shall be smooth, dry and free of major surface imperfections.

E. Roofing.

1. Fiberglass Shingles.

a. Shingles shall be fiberglass/asphalt type as manufactured by Johns-Mansville, Owens-Corning, Certain Teed or approved equal. Color and style shall be as selected by the Engineer.

b. Shingles shall have a manufacturer's 25-year warranty and shall be installed in strict accordance with the manufacturer's instructions using only recommended fasteners and procedures.

c. Nails or staples for fastening the shingles shall be sufficient length to penetrate completely through the plywood sheathing.

d. Eave Trim - Formed aluminum white drip edge trim.

e. Gable End Trim - Formed aluminum white drip edge trim.

2. Fasteners.

a. Use roofing manufacturer's recommended fasteners.

b. The roof system and/or components shall conform to the following applicable standards:

(1) Federal Specification - No. TT-C-17961 - Caulking Compounds, Metal Seam, and Wood Seam.

(2) Military Specification - MIL-S-4174B - Steel Sheet and Strip, Aluminum Coated, Low Carbon.

(3) American Iron and Steel Institute - Specification for the Design of Cold-Formed Steel Structural Members (Sep 1908 with Errata).

(4) American Society for Testing and Materials - Test Designation ASTM A446-76; ASTM A525 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality Property.

3. Underlayment.

a. The underlayment shall be 15-pound asphalt impregnated felt paper installed as recommended by the manufacturer.

F. Siding.

1. The exterior siding and accessories for the building shall be the solid vinyl type consisting of extruded polyvinyl chloride as defined in ASTM D3679.81a.

2. The horizontal siding panel dimensions shall be 8-inch exposure (nominal width), double-four design, by 12-feet 6-inches long by .040-inch minimum thickness.

3. The siding color shall be as chosen by the Engineer.

4. The siding components shall be as manufactured by ALCOA Building Products, Sidney, Ohio, or approved equal.

G. Gutters and Downspouts.

1. Gutters.

a. Shall be painted formed aluminum in standard residential size and furnished continuous or in as long lengths as possible to eliminate unnecessary joints. The gutters shall be installed in sections, as shown on the drawings and attached by gutter hangers spaced at minimum center spacing. Provide end caps and downspout fittings as necessary. Caulk all rivets, attachments, and joints. Color shall be white.

2. Downspouts.

a. Shall be rectangular painted aluminum furnished in as long lengths possible to eliminate unnecessary joints. Secure to gutter and section joints with blind rivets, each side, and of matching color. Provide matching downspout clips secured to walls on maximum 10'-0" centers. Color shall be white.

b. Downspouts shall discharge onto a concrete splash pad and shall direct water away from the building foundation to the ground surface.

3. Roof Ventilation.

a. Roof ventilation shall be provided by full vented soffit vents. The vents shall be white aluminum construction with insect proof openings.

H. Doors.

1. Exit Doors, Frames, and Hardware.

a. The emergency exit doors shall be exterior insulated steel door and frame units conforming to standards SDI-100 and CS242-62. The units shall be factory prime painted and consist of the following:

(1) The doors shall be full flush face type constructed of 18-gauge cold-rolled steel with 16-gauge reinforcement. The size shall be as called for on the contract drawings.

(2) Insulation shall be a complete core of expanded polystyrene with an R-value minimum of 4.0. Total door thickness shall be 1¾-inch.

(3) Hardware shall include three 4½-inch x 4½-inch full mortise template type hinges, one interior surface-mounted panic bar device (low profile) and one cylindrical lockset with sectional trim.

(4) Provide a glass vision panel where indicated on the project drawings.

(5) The frame shall be 18-gauge cold-rolled steel construction for attachment to 6-inch stud frame construction.

(6) Hardware reinforcement shall be provided where necessary.

(7) Provide a minimum of six anchors for wall attachment.

(8) Fire rating as required and shown on drawings.

2. Rolling Service Door.

a. Rolling service door shall be Cornell Ironworks Model CFW-6F or equal as manufactured by Cornell Ironworks, Mountaintop, PA.

b. Rolling service door shall include the following components:

1. Urethane insulation (⅞") R=6.33.

2. Weather seal system-complete joint and perimeter.

c. Door size shall be as indicated on the contract drawings.

I. Windows.

1. Exterior windows shall be casement glass units of white vinyl coated wood frame construction with 1-inch insulated glass.

2. Window shall be manufactured by Anderson Window Co., size as indicated on the contract drawings.

J. Insulation.

1. Insulation shall be fiberglass type as manufactured by Owens Corning, Certain Teed, or approved equal, and shall be installed as follows:

a. Walls 6¼-inches, R=19.

b. Ceilings - 9½-inches, R=30.

K. Interior Finishes.

1. Floor Tile (Office, Foyer).

a. Floor finish shall be of a good quality, commercial grade, vinyl composition tile as manufactured by Armstrong, Tarkett, or equal.

b. Size: 12-inch x 12-inch square, ⅛-inch thick.

c. Color: White with gray flecks.

d. Areas Covered: Office, entry.

2. Paint.

a. Base Coat: Contractor shall apply one complete coat of Sherwin-Williams oil based primer sealer over interior walls and ceilings.

b. Finish Coat: Contractor shall apply one complete coat of Sherwin-Williams latex interior paint over interior walls and ceilings.

L. Heating and Ventilation.

1. The heating and ventilation system shall be as indicated on the contract drawings, and shall include the following:

a. Wastewater Treatment Building

(1) Office/Foyer - Electric resistance heaters and positive purge ventilated system providing a net positive air pressure in these areas.

(2) Water Treatment Room - Class 1, Division 1 electric resistance heater as specified on the Contract Drawings.

b. Wastewater Transfer Building

(1) Class 1, Division 1 electric resistance heater as specified on the Contract Drawings.

M. Lighting and Electrical System.

1. The lighting and electrical system shall be as indicated on the Contract Drawings and as specified in Section 16 - ELECTRICAL.

PART 3 - EXECUTION

3.01 CONCRETE CONSTRUCTION

A. Placing Concrete shall comply with the requirements of Section 03300 - CAST-IN-PLACE CONCRETE.

B. Concrete Finish shall comply with the requirements of Section 03350 - CONCRETE FINISHES.

C. Vapor Retarder.

1. A plasticized PVC sheet of 6 mills thickness having a vapor rating of 0.50 perms maximum shall be installed under the stone base. Seal joints in vapor retarder and seal to other surfaces at extremities. Seal over tears and punctures with tape or adhesively applied strips of vapor barrier material as recommended by vapor retarder manufacturer to maintain vapor rating for entire barrier.

D. Control Joints.

1. Install ½-inch thick by 4-inch wide keyed expansion/contraction control joint material between each concrete slab. Material type to be as manufactured by George L. Wilson and Company, Inc., Pittsburgh, Pennsylvania, or approved equal.

2. Saw cut contraction joints shall be 1½-inch deep minimum. Cuts shall be made straight on chalked lines on the hardened concrete.

3. Isolation joints shall be located between slabs on grade and walls, and around columns or other parts of the structure that have separate foundations. Isolation joints around columns shall be circular or diamond shaped so the corners or other joints intersect. Forming is required to assure square joints.

4. All control joints shall be as located on the project drawings as required by proper construction practices. Consult Engineer if trouble arises in placement of the proposed control joints.

E. Building Anchors.

1. Install steel anchors with threaded ends complete with flat washers and hex nuts. The anchors shall extend into the masonry foundation 18-inches minimum with 3-inches of thread extending above. The anchors shall be ⅝-inch diameter at 6'-0" O.C. maximum.

3.02 MASONRY CONSTRUCTION

A. General.

1. Construct 8-inch concrete block walls to enclose the proposed building foundation as shown on the drawings.

B. Joints.

1. Joint sizes shall be uniform and shall suit the modular size of the masonry units. Newly laid masonry shall be protected from exposure to precipitation, freezing, excessive drying, soiling, backfilling and other hazards. After the mortar is thoroughly set and cured, large particles shall be removed with wooden paddles and nonmetallic scrape hoes or chisels.

2. The horizontal and vertical joints between masonry units shall be tool struck and smooth.

C. Joint Reinforcement.

1. Horizontal joint reinforcement shall be installed in intervals not exceeding 24-inches vertically. Joint reinforcement shall be truss type, as manufactured by Dur-0-Wall, Inc., or equal.

D. Installation.

1. Concrete masonry units shall be installed in a running bond pattern. The use of less than ½-size units shall be avoided. Unit masonry shall be cleaned to comply with the manufacturer's directions.

3.03 LIGHT GAUGE STEEL FRAMING

A. Fastening of components shall be with self-drilling screws or welding. Screws shall be of sufficient size to insure the strength of the connection. All welds shall be touched up with a zinc-rich paint.

B. Track shall be securely anchored to the supporting structure.

C. Studs shall be installed plumb, aligned, and securely attached to both flanges of both upper and lower track.

3.04 CARPENTRY

A. The Contractor shall provide all necessary labor and perform all carpentry work. He shall lay out all work and be responsible for all measurements, and keep a competent foreman in charge. All work shall be done in substantial conformity with the drawings and specifications and any changes or amendments thereof must be approved in writing by the Engineer.

B. Shoddy workmanship, unsightly appearance or noticeable imperfections shall be repaired or replaced at Contractor's expense.

3.05 ROOFING

A. The Contractor shall install roofing materials in accordance with the manufacturer's recommendations.

3.06 INSULATION

A. Fiberglass insulation shall be installed in building walls and ceilings as previously specified and as indicated on the contract drawings.

B. All cracks and openings around window and door framework shall be filled with the above insulation installed in strict accordance with manufacturer's instructions.

3.07 INTERIOR FINISHES

A. Floor Tile.

1. Provide all adhesives, underlayment, and accessories necessary for a complete installation.

2. Clean, prepare, and install per manufacturer's instructions.

3.08 GYPSUM WALL BOARD

A. The Gypsum board wall covering in all areas shall receive one complete, smooth coat of wall board primer to prepare the wall for paint, wallpaper, or other surface finish.

B. Cover all exterior corners throughout with angle shaped metal lath. All plaster shall be two-coat work of a standard brand of dry wall joint compound mixed in accordance with manufacturer's directions and shall be straight and true with cracks and seams tapered. Plastering contractor shall repair all defects and so all patching necessary to leave the work in good condition.

C. Provide Gypsum wallboard complying with Federal Specification SS-L-30D, in 48-inch widths and in such lengths as will result in a minimum of joints of the following types:

1. Regular Wallboard: Provide Type III, Grade R, Class 1, ½-inch thick except as may be shown otherwise on the drawings.

2. Water-resistant Wallboard: Provide Type VII, Grade W or X as required, Class 2, ⅝-inch thick except as may be shown otherwise on the drawings. Water treatment room walls shall be backed with ¾-inch cdx plywood.

3.09 PAINT

A. The Contractor shall properly prepare the wall surfaces and apply the specified coatings as recommended by the manufacturer.

3.10 CLOSING-IN OR UNINSPECTED WORK

A. Do not allow or cause any of the work of this section to be covered up or enclosed until it has been inspected, tested, and approved by the Engineer and by all other authorities having jurisdiction.

B. Should any of the work of the before-mentioned sections be covered up or enclosed before it has been completely inspected, tested, and approved, do all things necessary to uncover all such work. After the work has been completely inspected, tested and approved, provide all materials and labor necessary and make all repairs necessary to restore the work to its original and proper condition at not additional cost to the ECC Trusts.

3.11 COOPERATION WITH OTHER TRADES

A. Do all things necessary to cooperate with other trades in order that all systems in the work may be installed in the best arrangement. Coordinate as required with all other trades to share space in common areas and to provide the maximum of access to each system.

3.12 CLEANUP

A. Keep premises in a neat, safe, and orderly condition at all times during all phases of construction work. At the end of each day, and more often if necessary, sweep all areas affected by work performed under this contract. Remove all unnecessary refuse from construction site daily. Rope-off and secure any areas that may present a public risk when site is to be unattended.

3.13 SAFETY MONITORING

A. Routine vapor VOC monitoring shall be performed by the Contractor in the building interior areas as required by the Health and Safety Plan. Vapor monitoring shall also be conducted during periods of suspected treatment system leaks, wastewater spills, and carbon system replacement. All monitoring data shall be recorded in the site safety logbook.

END OF SECTION

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13200 - SOIL VAPOR EXTRACTION SYSTEM OPERATIONS START-UP

PART 1 - GENERAL

1.01 SUMMARY

A. This Section provides general guidelines and minimum standards relating to Operations Start-Up of the Soil Vapor Extraction (SVE) System. Start-up activities will commence after final inspection and approval of SVE system construction by the Engineer.

1.02 SECTION INCLUDES

A. Pre-start-up inspection, testing, and calibration.

B. SVE System Operations Start-Up.

C. SVE System Operations Start-Up Report.

D. SVE System long term operations.

1.03 RELATED SECTIONS

A. Section 13100 - SOIL VAPOR EXTRACTION SYSTEM

B. Section 13210 - SITE OPERATIONS AND MAINTENANCE

C. Section 13050 - WASTEWATER STORAGE AND TRANSFER SYSTEMS

D. Section 16400 - ELECTRICAL SERVICE AND DISTRIBUTION

E. Section 16600 - SPECIAL SYSTEMS

1.04 SUBMITTALS

A. General

1. The Contractor shall deliver submittals in accordance with the requirements of Section 01300 - SUBMITTALS.

B. Pre-Start-Up Inspection, Testing, and Calibration Checklist (Uncompleted)

1. The Contractor shall submit a detailed pre-start-up inspection, testing, and calibration checklist.

2. The pre-start-up inspection, testing, and calibration checklist for the SVE System shall include at a minimum the following:

   a. Electrical service and distribution circuit testing.

   b. Piping leakage testing.

   c. SVE System component testing including:

      (1) Blower(s)

      (2) Air-Water Separator(s)

      (3) Heat Exchanger(s)

      (4) Vapor Treatment Unit(s)

      (5) Misc. System Specific Components.

   d. Instrumentation and controls connection, calibration, and testing.

3. The pre-start-up inspection, testing, and calibration checklist shall be in tabular form with the following columns listed:

   a. Item inspected, tested or calibrated

   b. Brief description of activity performed

   c. Date performed (blank)

   d. Results (blank)

   e. Initials (blank)

4. The pre-start-up inspection, testing and calibration checklist shall address the specifics of the SVE System. Piping tests, electrical circuit tests, system components, instrumentation, and controls shall be logically organized based on system design (i.e. Northwest Soil Vapor Extraction lateral, Northwest blower circuit, etc.). A segmented approach to inspection, testing, and

calibration, if consistent with the SVE System design, will allow for approval of these subsystems for Operations Start-Up.

C. Pre-Start-Up Inspection, Testing, and Calibration Checklist (Completed)

1. The Contractor shall submit the completed pre-start-up checklists after inspection testing and calibration have been completed.

D. Operations Start-Up Data Collection Plan

1. The Contractor shall submit an Operations Start-Up Data Collection Plan detailing the method(s) of data collection, types of data to be collected, and frequency of data collection.

2. The Operations Start-Up Data Collection Plan shall be consistent with the requirements of Section 01392 - ENVIRONMENTAL SAMPLING AND QUALITY ASSURANCE, and Section 13210 - SITE OPERATIONS AND MAINTENANCE.

3. The Operations Start-Up Data Collection Plan shall include physical SVE System parameters (flow rates, vacuum pressure, etc.) as well as chemical monitoring.

4. The Operations Start-Up Data Collection Plan shall identify specific data collection points on the SVE System.

5. The Operations Start-Up Data Collection Plan shall include blank forms which identify how data will be tabulated during SVE System Operations Start-Up.

E. Operations Start-Up Report

1. The Contractor shall submit an Operations Start-Up Report.

2. The Operations Start-Up Report shall be a bound document consisting of but not limited to the following information.

   a. Introduction

   b. System Description

   c. Pre-Start-Up inspection, testing, and calibration checklists (completed)

d. Narrative of start-up activities, problems, and actions taken

e. Operations Start-Up Data Collection Plan including tabulated data

f. Long term operations recommendations

1.05 SEQUENCING

A. The Enviro-Chem Trustees Engineer shall be notified of the scheduled date for Operations Start-Up. The sequencing of Pre-Start-Up activities will be based on this scheduled date. All start-up activities must be initiated after approval by the Engineer of SVE System Construction.

B. The Sequence of Operation Start-Up activities shall be as follows:

1. Two weeks prior to the scheduled Operations Start-Up

   a. Contractor to submit inspection, testing, and calibration checklist (uncompleted) for review.

   b. Contractor to submit Operations Start-Up Data Collection Plan for review.

2. One week prior to the scheduled Operations Start-Up

   a. Approval of Pre-Start-Up inspection, testing, and calibration checklist.

   b. Begin Pre-Start-Up inspection, testing, and calibration activities (one week duration anticipated).

3. Prior to Operations Start-Up

   a. Contractor to submit completed inspection, testing, and calibration checklists.

   b. Approval of Operations Start-Up Data Collection Plan.

   c. Approval to begin Operations Start-Up.

4. Operations Start-Up

   a. Contractor to begin Operations Start-Up (Four week duration).

b. Contractor to submit weekly during Operations Start-Up, raw tabulated data in accordance with the Operation Start-Up Data Collection Plan.

c. Completion of Operations Start-Up activities.

5. Four weeks after completion of Operations Start-Up

a. Contractor to submit Operations Start-Up Report. (Shakedown Report)

C. The Contractor shall continue operations of the SVE System after completion of the start-up period. The Operations and Maintenance period shall begin, without interruption, after the 4-week start-up period. (Feb. 1, 1999)

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 INSPECTION, TESTING, AND CALIBRATION

A. The Pre-Start-Up inspection, testing and calibration activities are to be performed during a one week period preceding Operations Start-Up.

B. The purpose of these activities is to document and verify that the SVE System is properly installed and fully operational for start-up.

C. The Contractor shall make all adjustments to deficient work, correct defects, and calibrate equipment in accordance with the manufacturers recommendations and the approved SVE System design.

D. Approval for Operations Start-Up will be given by the Enviro-Chem Trustees Engineer only after all inspection, testing, and calibration activities are completed.

3.02 OPERATIONS START-UP

A. The Contractor shall begin Operations Start-Up in accordance with part 1.05 of this section.

B. The duration of Operations Start-Up will be four weeks unless otherwise directed by the Engineer.

C. The Contractor shall initiate the SVE System Operations Start-Up by energizing the appropriate circuits in the required sequence necessary for SVE System operation.

D. Upon commencing SVE System Operations Start-Up, the Contractor shall make adjustments to bring the System within the parameters identified for optimum operation in the design. Individual wells, laterals, manifolds and/or trench pipes associated with vapor extraction shall be tested for vacuum pressure and/or air flow rates. Adjustments to blower(s), control valves, etc. shall then be made in accordance with Section 13210 - SITE OPERATIONS AND MAINTENANCE.

E. Physical and chemical monitoring activities in accordance with the SVE System design and Section 01392 - ENVIRONMENTAL SAMPLING AND QUALITY ASSURANCE and Section 13210 - SITE OPERATIONS AND MAINTENANCE, shall occur throughout Operations Start-Up. Documentation of physical and chemical monitoring shall be in accordance with the Operations Start-Up Data Collection Plan.

F. Upon completion of the Operations Start-Up, the SVE System shall be fully operational and meet the functional design requirements.

G. All activities performed, adjustments made, and changes to the SVE System shall be documented for inclusion in the Operations Start-Up Report.

3.03 LONG TERM OPERATIONS

A. Upon completion of the four week Operations Start-Up, the SVE System shall be operated in accordance with the guidelines of the Site Operation and Maintenance Manual.

END OF SECTION

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13210 - SITE OPERATIONS AND MAINTENANCE

Rev. 5, 5/28/97

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes general guidelines and minimum standards for the Contractor relating to operation and maintenance of all remedial systems and components including mechanical and electrical equipment, monitoring equipment, and site facilities. Soil vapor extraction system performance and cleanup criteria are also described in this section.

B. Preliminary effluent limits for on-site discharge have been provided by IDEM Office of Water Management. See Table 2-2 of the Final Design Report. These preliminary limits are based on discharge to Finley Creek or one of its tributary streams (unnamed ditch). These preliminary limits are subject to change based on ongoing negotiations with IDEM. Final limits may be different.

1.02 SECTION INCLUDES

A. Soil Vapor Extraction System

B. Wastewater Storage and Transfer System

C. Wastewater Treatment System

D. Monitoring Wells

E. Final Cover and Drainage

F. Access Roads, Support Zone, and Fencing

G. Permanent Structures

1.03 RELATED SECTIONS

A. Section 13100 - SOIL VAPOR EXTRACTION SYSTEM

B. Section 13200 - SOIL VAPOR EXTRACTION SYSTEM OPERATIONS START-UP

C. Section 13050 - WASTEWATER STORAGE AND TRANSFER SYSTEMS

D. Section 01392 - ENVIRONMENTAL SAMPLING AND QUALITY ASSURANCE

E. Section 02280 - GEOTEXTILES

F. Section 02281 - HDPE MEMBRANE

G. Section 02282 - GEOSYNTHETIC DRAINAGE LAYER

H. Section 02500 - ACCESS ROADS, SUPPORT ZONE, EQUIPMENT LAYDOWN AREA, AND PARKING AREAS

1.04 SUBMITTALS

A. General

1. The Contractor shall deliver submittals in accordance with the requirements of Section 01300 - SUBMITTALS.

B. Site Operation and Maintenance Manual

1. A Site Operation and Maintenance Manual (Site O & M Manual) shall be submitted after completion of the SVE Systems Operations Start-Up. Final acceptance of the SVE System and Wastewater Storage and Transfer Systems will follow approval of the Site O&M Manual. A sample outline is provided to illustrate important topics and the level of detail expected in the Site O&M Manual submittal.

2. Sample Site O&M Manual Outline:

1.0	Introduction
1.1	Guide To Use Of This Manual
2.0	Systems Description
2.1	Soil Vapor Extraction System
2.2	Wastewater Storage and Transfer System
2.3	Wastewater Treatment System
2.4	Final Cover and Drainage
2.5	Access Roads
2.6	Fencing and Gates

2.7	Structures
2.8	Monitoring Wells
2.9	Backup Power System
3.0	Principals of Systems Operation
3.1	Remedial Action Goals
4.0	Operation
4.1	Soil Vapor Extraction System Operation
4.2	Wastewater Storage and Transfer System Operation
4.3	Wastewater Treatment System Operation
4.4	SVE System Performance Monitoring
5.0	Inspection and Maintenance
5.1	Inspection
5.1.1	Soil Vapor Extraction System Inspection
5.1.2	Wastewater Storage and Transfer System Inspection
5.1.3	Wastewater Treatment System Inspection
5.1.4	Final Cover and Drainage Inspection
5.1.5	Access Roads Inspection
5.1.6	Fencing Inspection
5.1.7	Structures Inspection
5.1.8	Monitoring Wells Inspection
5.1.9	Inspection Schedule(s)
5.2	Maintenance
5.2.1	Soil Vapor Extraction System Maintenance
5.2.2	Wastewater Storage and Transfer System Maintenance.
5.2.3	Wastewater Treatment System Maintenance
5.2.4	Final Cover and Drainage Maintenance
5.2.5	Access Roads Maintenance
5.2.6	Fencing Maintenance
5.2.7	Structures Maintenance
5.2.8	Monitoring Wells Maintenance
5.2.9	Maintenance Schedule(s)
5.2.10	Backup Equipment
6.0	Reporting and Documentation
7.0	System(s) Shutdown and Demobilization

3. Attachments

a. Weekly Operation Logs
b. Reporting and Documentation Forms

c. Technical Specifications
d. Record Drawings
e. Manufacturers Specific Equipment Operation and Maintenance Literature
f. SVE System Operations Start-Up Report

1.05 SEQUENCING AND SCHEDULING

A. Proper execution of this Specification and the associated Site O&M Manual can only occur after the SVE System Operations Start-Up is successfully completed (see Section 13200 - SOIL VAPOR EXTRACTION SYSTEM OPERATIONS START-UP).

B. The focus of this Specification is on the long term operation and maintenance of the SVE System, Wastewater Treatment and Storage Systems, and other site facilities, and performance monitoring and shutdown of the SVE system.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 GENERAL

A. The contractor shall provide a part-time operator during SVE System Operations. The operator shall be present onsite a minimum of 8 hours per week.

B. The wastewater treatment system shall be operated under the full-time supervision of an on-site operator. The operator must be a licensed wastewater treatment plant operator in the State of Indiana.

C. The purpose of the Site O&M Manual is to assure efficient operation of equipment and facilities, and to maintain equipment in accordance with the manufacturers recommendations thereby minimizing replacement and repair costs.

The Site O&M Manual shall provide operations and maintenance personnel with a document which contains technical information on all materials, equipment, and facilities found on site.

D. Backup (standby) equipment shall be provided by the Contractor and shall be available onsite to minimize downtime of any major system component, including pumps, instrumentation and monitoring equipment.

3.02 INSPECTION

A. To ensure the continued proper functioning of the various systems and facilities on site, scheduled inspections shall be performed.

B. Inspections shall be performed by qualified inspectors thoroughly familiar with the system and/or facility being inspected, and capable of evaluating the performance of these systems and/or facilities.

C. Inspections shall be performed at regular intervals as approved by the Enviro-Chem Trustee's Engineer.

D. Defects or deficiencies observed during inspections shall be documented in accordance with the Site Operation and Maintenance Manual.

3.03 MAINTENANCE

A. The Contractor shall perform scheduled maintenance in accordance with the site O&M Manual and manufacturers recommendations. Scheduled maintenance shall include activities which are performed on a periodic basis to retain system and/or facility functionality.

B. The Contractor shall also perform unscheduled maintenance on systems and/or facilities which may include adjustments, calibration, repair and replacement activities.

C. All maintenance activities shall be performed by qualified personnel thoroughly familiar with the maintenance activities and capable of trouble shooting system and/or facility problems.

3.04 SOIL VAPOR EXTRACTION SYSTEM

A. The Contractor shall establish operation and maintenance procedures for the SVE System which shall be submitted to the Enviro-Chem Trustees Engineer for approval. These procedures shall be submitted as part of the Site O&M Manual outlined in Part 1.04.B.2 of this section.

The vapor extraction process is intended to operate continuously. It will shut down automatically only in the event of an operating problem or malfunction. The following are conditions which will shut down normal operating sequence of the vapor extraction system:

1. High vapor temperatures above the estimated acceptance range of 120°F prior to activated carbon treatment, if used;

2. High relative humidity above the acceptable value of 50% prior to an activated carbon unit, if used;

3. High water level in water entrainment separator indicating operating problems with liquid transfer operation;

4. High water level in water storage tank T1 or T2;

5. High total VOC levels above the acceptable value of 25% of the Lower Explosive Limit (LEL) of the VOC mixture, prior to an oxidizer (thermal, catalytic) or a flare, if used;

6. High or low pressure conditions on vacuum or injection pumps under normal operating conditions; and

7. Power interruptions at the site.

During normal operation, vapor extraction may be stopped to facilitate carbon vessel change out and during transfer of water from the entrainment separator to the on-site water storage tank, or to conduct restart spike tests.

B. The air extracted from the SVE System will be monitored as shown on the general process and instrumentation diagram (Figure 2-3) of Exhibit A. The capability will exist to sample individual well and/or trench exhausts or the combined air stream. Sample taps also will be provided to collect vapor samples for detailed chemical analysis. At a minimum, the instrumentation will include a photoionization detector (PID) for VOCs, a thermocouple, a pressure indicator, a flowmeter, and moisture analyzer. The vacuum pump, controls, and instrumentation will be protected from the elements.

Air flow rates shall be measured, at the stack tap, for the air treatment system discharge, at a minimum once per day and during emissions sampling events, to calculate the total mass flow rate (lb/hr) of the VOCs.

C. The Contractor shall be responsible for implementing SVE System O&M procedures until the SVE System is shut down and demobilization is completed. Shutdown of the system will be based on meeting criteria for soil cleanup verification as described in Part 3.12.A of this specification. Demobilization of the system is described in specification SECTION 01710 - DEMOBILIZATION.

3.05 WASTEWATER STORAGE AND TRANSFER SYSTEMS

A. Storage Tanks

1. The Contractor shall perform weekly inspections on the storage tanks and the tank T2 cover and vent treatment system. Spent carbon canisters shall be disposed of offsite in accordance with the manufacturers requirements.

2. Repairs and maintenance of the storage tanks shall be in accordance with the manufacturers recommendations.

3. If at any time during operation of the wastewater storage and transfer system the settled solids in the storage tanks reach 15% of the tank capacity, the Contractor shall remove and dispose of said solids in accordance with Section 02080 - REMEDIAL ACTION GENERATED WASTES.

B. Transfer System

1. Pumps shall be operated and maintained in accordance with manufacturers recommendations.

2. Contractor shall maintain one backup pump to replace either of the transfer pumps in the event of failure.

3. Operation of the transfer pump shall not be performed without an operator on site.

4. If tanker truck filling operations are implemented for the wastewater, the operator shall log the totalizer reading and calculate the required reading necessary to complete filling operations based on tanker capacity. The operator shall then begin pumping and monitor the totalizer reading to avoid overfilling the tanker. Upon completion of tanker filling, the transfer pump shall be shut off and the shut off valve shall be opened to drain the flexible discharge pipe into the wastewater storage pad sump.

C. Instrumentation and Controls

1. Instrumentation and controls shall be maintained in accordance with the manufacturers recommendations. Calibration and cleaning of instruments shall be performed on a scheduled basis.

2. Control and shut off valves shall be maintained leak free. Leaking valves shall be repaired or replaced immediately.

3.06 WASTEWATER TREATMENT SYSTEM

A. The Contractor shall establish operation and maintenance procedures for the wastewater treatment system. The procedures shall be in accordance with the manufacturer's recommended measures and the requirements of these specifications. Start-up and routine wastewater sampling and analyses requirements are described in the QAPP and FSP.

B. Special O & M Procedures.

1. Bag and Cartridge Filter Changeout.

(a) An increase in the filter pressure differential shall be noted and may indicate suspended solids buildup within the filters. The filter units shall be opened and media removed to remove solids, if present, in accordance with the manufacturer's recommended procedures. Spent media and filtered solids shall be disposed of according to specifications.

(b) The water filtration system shall be operated and maintained in accordance with the manufacturer's recommendations.

2. Pressure Testing.

(1) Pressure testing shall be performed on the filled adsorber systems and pipe racks to check for leaks prior to operation. Test pressure shall be at 100 percent of the manufacturer's recommended operating pressure. Once passed, the entire treatment train shall be pressure tested at 100 percent of operating pressure. During testing, all gauges and instrumentation shall be visually checked for proper indication.

3. Backflush.

(1) An increase in the adsorber pressure differential shall be noted and may indicate suspended solids buildup on the carbon bed. The adsorber shall be backflushed to remove solids, if present, in accordance with the manufacturer's recommended procedures. Backflush liquids shall be discharged into the wastewater storage Tank T2 upflow of the tank baffle. Clean backflush water shall be taken from Tank T3.

4. Spent Carbon Acceptance.

(1) The effluent from the lead carbon adsorbers (upstream in series) shall be periodically tested for contaminant breakthrough. At a minimum, weekly testing shall be performed during the first month of operations, and monthly testing shall be performed thereafter. The Contractor shall determine, in concurrence with the Engineer, acceptable breakthrough times to be used for system operation consistent with Parts 3.06, E.2 and F.3, and meeting with permit limits.

(2) Contaminant breakthrough shall be identified as the presence of any VOC or SVOC constituents above the breakthrough levels established for operation. Nominal breakthrough levels shall be the final IDEM discharge limits unless otherwise directed by the Engineer. Breakthrough identification shall initiate immediate actions by the Contractor to replace the activated carbon in the lead adsorber(s) and switch the flow sequence of the adsorbers.

(3) Prior to return of the spent carbon to the manufacturer, the spent carbon shall undergo acceptance testing. The acceptance canisters, or equivalent sampling device, shall be shipped for testing in accordance with the manufacturer's instructions. Fresh carbon shall be obtained upon satisfactory completion of the carbon acceptance procedure and verification by the manufacturer.

(4) The Contractor shall provide manufacturer's certification of carbon acceptance and fresh replacement carbon to the Enviro-Chem Trustees' Engineer.

5. Spent Carbon Discharge and Fresh Carbon Fill.

(1) Spent carbon may be removed from the site by the manufacturer or his authorized contractor or returned to the manufacturer. In no circumstances shall spent carbon be discharged onsite or hauled offsite for disposal by the Contractor.

(2) Spent carbon discharge and fresh carbon fill shall be performed in strict adherence of the manufacturer's recommended procedures.

C. Aeration System

1. The bubble diffuser aeration system shall be continuously operated during periods of wastewater treatment unless otherwise directed by the Engineer.

2. The aeration system blower and diffuser system shall be operated and maintained in accordance with the manufacturer's recommendations.

3. The aerator pipes should be monitored for any plugging by monitoring the pressure gauge on the main air supply line, downstream of the compressor. A high pressure alarm will indicate a need for cleaning the manifold. The cleaning system should not require downtime during wastewater treatment system operation.

D. System Start-Up

1. The raw wastewater treatment system shall be tested and started-up in accordance with the manufacturers' recommendations. System start-up will be completed after a minimum of 100,000 gallons of wastewater has been treated.

2. The following shall be inspected daily during startup:

(a) Air stripper media visual examination for potential clogging.

(b) Filter pressure loss and visual examination for clogging and/or damage.

(c) GAC vessel pressure loss, leakage and physical integrity.

(d) Diffuser blower mechanical system.

(e) Pumps and piping mechanical system, and

(F) Air stripper pressure drop.

3. The system start-up shall be documented in a wastewater treatment system start-up report. The report shall include copies of all laboratory reports and analytical results, to assure compliance with discharge permit. The report shall be submitted to the Enviro-Chem Trustees Engineer within 30 days after completion of the system start-up.

E. General Operations and Maintenance

1. The treatment system shall operate continuously as much as possible over minimum 8-hour shifts to process raw wastewater. Nominal treatment rate shall be 50 gpm. The treatment system may be operated 24 hours a day to treat wastewater that has accumulated in the storage tanks.

2. System operations shall be checked every four hours during periods of operation. This includes at least the following:

   a. storage tank levels and leak detection sumps
   b. flow rates
   c. pressure drops
   d. mechanical integrity
   e. storage tank sediment levels
   f. wastewater control panel and treatment room

3. Lead carbon adsorber effluent shall be sampled at a minimum of 100,000 gallon intervals for VOCs. Sampling shall initiate at the 50,000 gallon level unless otherwise determined during start-up. The sampling frequency for the lead adsorber may be modified based on the results of the start-up test and as approved by the Engineer. The lead adsorber shall be taken out of operation when VOC breakthrough concentrations greater than discharge limits have been reported. The lag adsorber shall be used as the lead adsorber to treat wastewaters and the spent lag adsorber shall be refilled with fresh carbon.

4. Treated wastewater shall meet the preliminary discharge limits provided by IDEM. Final limits may be different. Sampling and analyses of effluent shall be in accordance with the QAPP and as approved by IDEM and the Enviro-Chem Trustee's Engineer.

   Discharge shall be to the on-site drainage channel. Discharge rates shall be a maximum of 150 gpm. The discharge shall be measured for flow and visually inspected to assure that there is no erosion or degradation of the site drainage channels.

F. Off-site Disposal Contingency

1. The Contractor shall arrange for off-site disposal of the treated wastewater if the effluent cannot meet the IDEM discharge standards, or if it is not able to be returned to the raw wastewater storage tanks for retreatment. Off-site disposal shall be in accordance with Specification 02080 - REMEDIAL ACTION GENERATED WASTES.

3.07 MONITORING WELLS

A. Inspection

1. Monitoring wells shall be inspected during well monitoring events.

2. Inspections during these events shall include observation of the following:

a. Well casing integrity

b. Well cap and lock

c. Concrete Base (frost heave, cracks, etc.)

3. The Contractors shall document deficiencies in any of the inspected items and report them to the Engineer.

B. Maintenance

1. Upon notification of defects or deficiencies in monitoring well(s), the Contractor shall repair or replace the defective component.

2. In the event that a monitoring well is damaged beyond repair, the Contractor shall install a new monitoring well of like construction at an adjacent location approved by the Enviro-Chem Trustees Engineer.

3.08 FINAL COVER AND DRAINAGE

A. Vegetative Layer Maintenance

1. Vegetative layer maintenance includes the re-establishment of vegetation through seeding, sodding, mulching, and fertilizing and mowing of the SVE Treatment Zone cover, grass-lined ditches, swales, terraces and adjacent areas. These requirements address maintaining the vegetative cover at the site.

B. Seeding, and Mulching the Vegetative Layer

1. The establishment of the grass cover may require isolated reseeding during the first two to three years of growth to assure that the long-term grasses are adequately established. The mixture should be applied at a rate specified in Section 02710 - VEGETATION. The Specifications also include guidance for applying mulch when required.

C. Grass Mowing

1. The Contractor shall perform mowing operations during the typical growing season (May - October).

2. The areas to be maintained include the SVE Treatment Zone, the Support Zone, all grass lined storm drainage ditches, and areas outside the fenceline requiring access for inspection and/or maintenance.

3. The Contractor shall be aware of obstacles present due to SVE and Dewatering System Operations and take appropriate precautions during mowing operations.

D. Final Cover Maintenance

1. Burrowing animals present a special problem for ensuring the integrity of the final cover. Once a burrow has been located, it is important to identify the animal species that dug the hole. It may be necessary to consult the U.S. Fish and Wildlife Service for control methods. Non-destructive traps should be a first option for removing animals. An expert in the use of non-destructive traps may be needed to provide proper operation and use for this option. Extermination should be considered only after non-destructive options have been considered.

2. Visual inspection of the cover for burrowing animals consists of traversing the cover in an organized grid pattern to discover holes and/or mounds at the cover's surface. It is also essential that holes or burrows under the perimeter fence be repaired immediately.

3. After the animal has been removed, the burrow should be inspected. If the depth of the burrow penetrates the geotextile fabric above the geocomposite drainage net, repair of the drainage and barrier layer may be necessary. If the geotextile fabric has not been penetrated, the soil that has been burrowed should be replaced to its original condition. All repair work should be performed in accordance with the appropriate Specifications; however, the size of equipment employed will depend on the size and nature of the repairs.

4. Periodic inspection of the final cover may indicate the growth of seedlings of various native trees or shrubs. This should only occur when the grass cover has not been cut on a regular basis. However, root stubs may be visible after the grass cover has been cut. Maintenance personnel should remove as many of the trees or shrubs as possible, including the root system, during the inspections and prior to mowing the grass. Herbicides should not be used.

5. Periodic freezing and thawing may cause parts of the surficial cover system materials to become loose and heave due to the freeze/thaw cycles. Water may enter cracks which will expand and contract with freeze/thaw cycles. Inspection of the final cover for frost penetration should be conducted during burrow hole removal.

6. The final cover drainage system (Stage 2) is important to the proper function of the cover and the prevention of infiltration into the underlying soil. The drainage layer is composed of a geocomposite drainage net under 24 inches

of soil and topsoil. The drainage is designed to remove water that infiltrates through the overlying cover.

7. There are a variety of mechanisms that may cause the drainage layer to fail. Types of failure mechanisms include differential settling, deterioration of the synthetic materials, and exceeding the design flow rate. The assessment of the final cover drainage system should be conducted as part of the overall site inspection unless a potential problem is detected which warrants more frequent assessments. Indicators of drainage system failure include the following:

    a. The presence of ponded water or ice on the final cover.

    b. Erosion of topsoil or general fill material;

    c. The presence of isolated depressions on the final cover surface. Any subsidence shall be restored in accordance with the design specifications to provide positive drainage.

E. Drainage

1. Inspection of the storm water drainage channels shall include but not be limited to the following:

    a. Obstructions to Flow

    b. Erosion

    c. Excessive Siltation

    d. Inadequate Vegetation

2. Deficiencies found during drainage channel inspections shall be corrected. Drainage channels shall be brought back to original grade and revegetated as per the Specifications.

3.09 ACCESS ROADS, SUPPORT ZONE, AND FENCING

A. Access Roads

1. The Contractor shall maintain access road surfaces throughout the SVE System Operation.

2. The access roads shall be inspected periodically for signs of road surface degradation.

3. Washouts, depressions, and displacement of aggregate due to vehicular traffic shall be repaired immediately by regrading and/or placement of additional aggregate.

B. Support Zone

1. The support zone including the existing concrete decontamination pad, existing wastewater storage pad and temporary facilities shall be maintained throughout remediation activities.

C. Fencing

1. Site fencing and security features including gates, locks, and posts shall be inspected periodically for damage. The above items shall be inspected for the following:

    a. Proper function

    b. Damage

    c. Corrosion

2. Repairs to site fencing and security features shall be completed immediately upon detection.

3.10 PERMANENT STRUCTURES

A. The Contractor shall maintain all permanent structures during remediation activities.

B. The Contractor shall maintain the integrity of each building envelope including:

1. Roofing

2. Siding

3. Soffit

4. Windows

5. Doors

C. The HVAC and electrical service shall be maintained and remain functional at all times.

D. All security features including doors, locks, and hardware shall be kept fully operational.

E. Damage observed during remediation activities shall be repaired immediately upon detection.

F. Upon completion of remediation activities all permanent structures shall be turned over to the ECC Trust in the condition they were originally taken.

3.11 REPORTING AND DOCUMENTATION

A. Operating data, inspection and maintenance will be reported on forms prepared by the Contractor. The Contractor will develop and submit blank forms as part of the Site O&M Manual Submittal.

B. Completed operating data forms shall be submitted weekly to the Engineer. Completed inspection and maintenance forms shall be submitted monthly.

C. The following is a general listing of forms required:

1. SVE System Operational Data

2. Wastewater Transfer and Storage Systems Operational Data

3. Water Treatment System Operational Data

4. Monitoring Well Data

5. Inspection Forms

6. Maintenance Forms

7. Daily Log of Activities

3.12 SVE SYSTEM PERFORMANCE AND CLEANUP CRITERIA

A. General Performance and Cleanup Criteria

1. Performance criteria have been defined in the Enviro-Chem Site, Consent Decree, Revised Exhibit A to establish cleanup standards for remediation of the site contamination. Achievement of the cleanup standards shall be

measured by analyses of samples taken from onsite soils, surface water in the unnamed ditch, and groundwater (subsurface water) in onsite till wells and offsite wells (sand waterbearing zone and till wells).

The SVE Contractor shall be responsible for only the vapor sampling phase of the soil cleanup verification. The groundwater, surface water, and onsite soil sampling phases of the soil cleanup verification will be performed by others, independent of the Contractor.

2. Cleanup Standards - The following cleanup standards shall be met for successful completion of the SVE system program:

   a. Acceptable Soil Concentrations shown in Consent Decree, Table 3-1 will be achieved according to the procedure discussed in Section 2.01A.10 (a).

   b. Acceptable Stream Concentrations or Applicable Surface Water Background Concentrations shown in Consent Decree Exhibit A, Table 3-1 will be achieved in unnamed ditch south of and adjacent to the Enviro-Chem Site.

   c. Acceptable Subsurface Water Concentrations or Applicable Subsurface Water Background Concentrations shown in Consent Decree Exhibit A, Table 3-1 in the onsite till shall be achieved.

   d. Acceptable Stream Concentrations or Applicable Surface Water Background Concentrations shown in Consent Decree Exhibit A, Table 3-1 in the offsite wells shall be achieved.

3. The term "Table 3-1" wherever referred to or used in this Specification and in the Consent Decree includes the footnotes on pages 2 of 3 and 3 of 3 of that table.

4. Achievement of the cleanup standards will result in cessation of the SVE operations, however, post-soil cleanup surface water and groundwater compliance monitoring will continue for a period of 7 years. SVE operations may be completed for a portion of the site if achievement of cleanup standards can be demonstrated for that site area. The remaining site area would be remediated to achieve the cleanup standards at a later date, with precautions taken so as not to recontaminate the previously cleaned area.

5. The time to achieve cleanup standards for the entire site is expected to be 18 months or less.

6. If site cleanup is not achieved within 5 years, then the Additional Work provisions of the Consent Decree will apply. Additional Work provisions are not within the scope of these Specifications.

7. Verification of soil cleanup will be accomplished by:

   a. Soil vapor monitoring of SVE system restart spikes.

   b. Onsite subsurface till water monitoring.

   c. Onsite soil sampling.

8. The criteria to shutdown all or part of the SVE system is described in the following section (9). Once the SVE system is shutdown, the verification of soil cleanup procedure would be implemented.

9. Criteria for Shutdown of SVE System

   a. The vapor extraction system is designed to permit vapor samples to be obtained from each individual extraction trench, wellpoint, or wellpoint treatment cell, and from the combined vapor stream from the entire operating system, depending on the SVE method proposed by the selected Contractor.

   b. The combined system vapor flow will be sampled daily during the first week of operation, weekly for the following 3 weeks, and monthly thereafter. Samples will be analyzed for VOCs listed in Table 3-1 and phenol. Also, the vapor flow rate will be monitored and recorded to provide sufficient data to calculate the mass of organics removed from the soils and the effectiveness of the system. These data will also aid in estimating the treatment time remaining, based on the calculated mass extraction rate (lbs/day) of the VOCs listed in Table 3-1 and phenol.

   c. Vapor samples from individual extraction trenches, wellpoints, or wellpoint treatment cells will be collected at the beginning of the vapor extraction system operation to establish a baseline of organics removal per trench/cell. These samples will be analyzed for the VOCs listed in Table 3-1 and phenol. Once the mass rate extracted per day is reduced to 5 percent of the initial week's rate, additional vapor samples of individual trenches/wellpoints/cells will be collected at least every 2 months, to determine when individual extraction trenches/cells can be shutdown. The criterion for shutting down individual trenches/wellpoints/cells will be that two consecutive air samples from an individual trench/wellpoint/cell show vapor concentrations to be in equilibrium with the Acceptable Soil Concentrations in Table 3-1. Table 4-1 shows the soil vapor concentrations in equilibrium with the Acceptable Soil Concentrations for the VOCs listed in Table 3-1 and phenol.

10. Soil Cleanup Verification

a. Verification of soil cleanup will be established when each of the following is met:

(1) The soil vapor from the restart spike tests shows compliance with the calculated soil vapor concentrations in equilibrium with Acceptable Soil Concentrations for the VOCs listed in Table 3-1 and phenol ("Soil Vapor Criterion").

(2) Onsite till wells show compliance with the Acceptable Subsurface Water Concentrations specified in Table 3-1 or Applicable Subsurface Water Background Concentrations ("Onsite Till Water Criterion"). Sampling of onsite till wells will be performed by others, independent of the SVE Contractor.

(3) Soil samples show compliance with the Acceptable Soil Concentrations as specified in Table 3-1 ("Soil Sample Criterion"). Sampling of onsite soils will be performed by others, independent of the SVE Contractor.

b. If Soil Cleanup Verification is not established, vapor extraction will be restarted.

c. Monitoring procedures and monitoring well details are contained in the Post-Construction Monitoring Plan. Soil cleanup verification procedures are described in the following Sections 11, 12 and 13.

11. Soil Vapor Criterion

a. Once the combined vapor flow and individual trench, wellpoint, or wellpoint treatment cell vapor samples show concentration of Table 3-1, VOCs and phenol at or below their respective equilibrium soil vapor concentrations shown in Table 4-1, the "restart spike" method on the combined vapor flow will be used to demonstrate that the Soil Vapor Criterion for Soil Cleanup Verification has been achieved.

b. The "restart spike" method consists of periodically shutting down and restarting the vapor extraction system. By shutting down the system, equilibrium conditions between the vapor space within the soil and any remaining organics amenable to vapor extraction within the soil matrix are reestablished. Therefore, when the vapor extraction system is restarted, the initial organics concentration in the extracted gas will be higher than under normal operation.

c. The restart spike procedure will include shutting down the vapor extraction system for a period of 3 days. Upon restarting the vapor extraction system, all extraction trenches, wellpoints, or wellpoint treatment cells will be operated as during normal operation. A sample of the combined soil vapor will be collected over a 5-hour period starting 30 minutes after restarting the vapor extraction system. This sample is expected to be representative of the soil vapor concentrations in equilibrium with the soil concentrations based on a 500 SCFM system flow rate which will exchange an estimated one pore volume of soil over the entire treatment area every 5 hours.

d. The Soil Vapor Criterion will be met when analyses of soil vapor samples collected from four consecutive restart spikes conducted once every 2 weeks show that concentrations of VOCs and phenol in Table 3-1 are at or below equilibrium soil vapor concentrations shown in Table 4-1 and therefore by calculation can be shown to be at or below the Acceptable Soil Concentrations in Table 3-1.

12. Onsite Till Water Criterion

a. Samples of the subsurface water from the onsite till monitoring wells will be collected at the beginning of the SVE operation, quarterly for the first year, semi-annually for two years, and quarterly after that, if operation of the SVE system is continuing during such periods. Additional samples may be taken at the discretion of the representative of the ECC Trustees. The most recent sampling results for the four onsite till water monitoring wells following demonstration that the Soil Vapor Criterion has been achieved will be used to demonstrate that the Onsite Till Water Criterion for Soil Cleanup Verification has been achieved.

b. This criterion will be met when analyses of the water samples collected from each of the four onsite till wells show that the concentrations for parameters with Acceptable Subsurface Water Concentrations in Table 3-1 are at or below the Acceptable

Subsurface Water Concentrations in Table 3-1 or Applicable Subsurface Water Background Concentrations.

13. Soil Sample Criterion

a. Once the Soil Vapor Criterion and Onsite Till Water Criterion for Soil Cleanup Verification have been demonstrated as defined above, a minimum of 20 soil samples from areas selected by U.S. EPA and the state will be collected.

b. Each soil sample will be analyzed for the VOCs in Table 3-1 and phenol. Verification of this criterion for all VOCs in Table 3-1 and phenol relative to the Acceptable Soil Concentrations in Table 3-1 have been met, then the Soil Sample Criterion for Soil Cleanup Verification will have been achieved.

c. In the event that the soil sampling results do not verify that the Acceptable Soil Concentrations as defined in Table 3-1 have been met, and the soil vapor extraction system is operated for an additional period of time, additional soil samples will be taken in the same approximate locations (i.e., within a 3-foot radius) as the initial sample locations where acceptable soil concentrations had not been shown. Results from this second sampling will be analyzed using the identical procedure outline above to verify that the Acceptable Soil Concentrations in Table 3-1 as described in Footnote 6 of Table 3-1 have been met. If the results from any subsequent round of soil samples demonstrate that the Acceptable Soil Concentrations in Table 3-1 have been met, then the Soil Sample Criterion for Soil Cleanup Verification will have been achieved.

14. Modifications to Criteria

a. No changes shall be made to the consent decree performance criteria unless approved by the Engineer, U.S. EPA and IDEM.

END OF SECTION

DIVISION 16 - ELECTRICAL

SECTION 16010 - GENERAL ELECTRICAL WORK

PART 1 - GENERAL

1.01 FAMILIARIZATION WITH PROJECT

A. The Contractor shall be thoroughly familiar with the extent and nature of the work before submitting a bid for this project.

B. The Contractor shall be held responsible for a thorough first-hand knowledge of site conditions and their implications for the work of this project.

1.02 DEFINITIONS

A. The following definitions of terms used herein shall apply to this Contract:

1. "Furnish" or "Provide" shall mean to supply, erect, install, connect, and test complete and ready for regular operation, the particular work referred to unless specifically indicated or specified otherwise.

2. "Work" shall mean all labor, materials, equipment, apparatus, controls, tests, accessories, and all other items customarily furnished and/or required for proper and complete installation of a specific piece of equipment or system.

3. "Wiring" shall mean and include conduit, fittings, straps, supports, wire, connectors, cables, tape, junction and outlet boxes, switches, cutouts, receptacles, splices, and all other items necessary and/or required in connection with such wiring.

4. "Indicated" or "Noted" shall mean as indicated or noted on the Drawings and/or in these Specifications.

1.03 ELECTRICAL SCOPE

A. Furnish and install the complete electrical system detailed on the Drawings and as indicated specifically or through performance specifications in this section and others, including, but not limited to:

1. Electrical conduits, ducts, and wiring.

2. Panels for controls and instrumentation.

3. Boxes, receptacles, and plates.

4. Electrical service and distribution.

5. Grounding of all conduit and equipment.

6. Instrumentation devices and controls.

7. Connection to motors, alarms, and switches.

B. Furnish and install additional materials necessary for a complete and operating electrical system consistent with the design intent depicted on the Drawings , even if not specifically shown.

C. Secure and pay for all permits, inspections, tests, etc. as required by local, state, and Federal regulations.

D. Testing.

E. Excavating for Electrical Work:

1. No excavation for electrical work shall be permitted within the remedial boundary (except for utility poles). All electrical service and distribution in this area shall be overhead or above ground encased in conduit.

2. Do not excavate for electrical work until work is ready to proceed without delay, so that total time lapse from excavation to backfill is minimized.

3. Locate and protect existing utilities and underground work in a manner that will ensure that no damage or service interruption will result from excavation and backfilling.

4. Notify the Engineer before beginning any and each excavation. At this time, exact locations of underground service to be installed shall be determined by inspection and approval of the Enviro-Chem Trustees Engineer (Engineer). Wherever underground utilities are known to exist in the area of required excavations, such facilities shall be located exactly by hand excavation by the Contractor. Should any minor relocation of new facilities be required before installation, the Contractor shall make the necessary relocation at no extra cost to the ECC Trusts.

5. Excavate trenches to depth indicated or required. Except as otherwise required, backfill with properly qualified material. Backfill to elevations

matching adjacent grades at time of completion of project or as required to provide patching of paved surfaces.

6. Excavate with vertical-sided excavations to the greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross bracing to sustain sides of excavations. Remove sheeting and cross bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at sufficient distance below finished grade to not interfere with other work.

7. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

F. Coordination of Incoming Services:

1. The Contractor shall be responsible for making arrangements with the local power company relative to a timely installation of the incoming electric service and for coordination of his work with that of the power company.

2. A complete layout of incoming services including all equipment furnished by the Contractor and utilities shall be submitted.

3. The incoming service shall be inspected and approved by the local power company.

4. A certificate of inspection from the above agency shall be provided before the energization of incoming service.

5. A copy of the inspection certificate from the local electrical inspection agency for the incoming electrical service shall be submitted to the Engineer.

1.04 INTENT OF PLANS AND SPECIFICATIONS

A. Intent:

1. The Drawings and the sections of the Specifications are complementary each to the other.

2. Materials and work which are indicated in one, shall be as binding as if indicated in both.

3. The Drawings are intended to indicate only diagrammatically the extent, general character, and approximate locations of the work included.

4. Exact locations must be coordinated with local conditions and with other trades.

5. Work indicated but having minor details obviously omitted, shall be furnished complete to perform the functions intended without additional cost to the ECC Trusts.

6. Follow Structural and Mechanical Drawings and this section of the work fitted thereto.

7. All equipment shown on the Drawings is intended to be generally representative of the equipment which will be installed under this Contract, but it shall not be assumed that the Drawings indicate the specific configuration, arrangement, or points of connection of the actual equipment which will be purchased.

8. The entire work provided for in these Specifications shall be constructed and finished in every respect in a workmanlike and substantial manner, according to the accompanying Drawings and these Specifications.

9. The bidder shall include in his bid, all cost required to adapt the actual equipment he intends to purchase to the general layout indicated on the Drawings and to provide a complete and operable system.

10. Typical details shown on the Drawings shall apply to each and every item of the project where such items are incorporated; details are not repeated in full on all Drawings, but the intention that such details shall be applicable in full.

B. Location Approximate:

1. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only.

2. The Contractor shall determine the exact locations of the equipment, outlets, box-outs, sleeves, and of similar items required for the coordination of electrical work with the structural, architectural, mechanical, and other work.

C. Drawings Diagrammatic:

1. Circuit diagrams shown are diagrammatic and functional only and are not intended to show exact circuit layouts, number of fittings, or other installation details.

2. The Contractor shall furnish all labor and materials necessary to install and place in satisfactory operation all power and other electrical systems as shown.

3. Power conduits and wire sizes are called out on the electrical one-line diagram. Control and instrument home runs are shown on the relevant electrical plan view.

   a. The number of conductors shown is not necessarily the correct number required.

   b. As many conductors as are required in each case shall be installed.

   c. More than three current carrying conductors may be installed in a raceway as long as the wire capacity is derated per Section 310-15 (8) (a) Adjustment Factors of the National Electric Code.

   d. A ground conductor in accordance with "Electrical Grounding" shall be furnished with every electrical circuit.

D. Departure From the Drawings :

1. Submit details of such departures and the reasons therefore as soon as practical and within 30 days after award of the Contract.

2. No departures shall be made without signed approval.

E. Coordination:

1. The Contractor shall keep himself fully informed as to the size, shape, and location of all openings required for his pipes and apparatus and shall give full information to the other trades so that the openings may be built in advance. The walls and ceiling of the Office provide a vapor seal between the Office and the Treatment Room allowing the Office to be an unclassified area. The contractor shall provide a vapor seal for all holes or sleeves that are required for conduit passage from the Office to the Treatment Room.

2. It shall be the responsibility of the Contractor to pay all costs for subletting any work under this section in order to avoid work stoppages due to jurisdictional disputes.

3. The Contractor shall confer with all other trades relative to the location of apparatus and equipment and select locations so as not to conflict with work of other trades.

4. Any conflict with other trades shall be referred immediately to the Engineer for resolution.

5. If interference occurs, the Engineer will determine which work is to be relocated, regardless of which was first installed.

F. Discrepancies:

1. If the Contractor, in the course of the work, finds any discrepancies between Drawings or equipment listed and the physical conditions of the site, or any errors or omissions in the dimensions or instructions given by Drawings or equipment lists, he shall immediately notify the Engineer, in writing, and the Engineer shall promptly adjust the same.

2. Any work performed after such discovery, unless authorized by the ECC Trusts in writing, shall be at the Contractor's risk.

3. The Drawings are, in general, made to scale, but all measurements shall be taken from figured dimensions, and not by scaling.

4. Whether or not an error is believed to exist, deviations from the Drawings and dimensions given thereon shall be made only after written approval.

5. The Contractor shall be responsible for comparing all Drawings and verifying all dimensions before laying out the work.

6. When measurements are affected by existing conditions, the Contractor shall take necessary field measurements and refer any differences in dimensions to the Engineer.

7. Any and all errors in the work that might have been avoided by such field measurements shall be the responsibility of the Contractor.

8. When submitting proposal, give written notice to the ECC Trusts of any materials or apparatus in violation of laws, ordinances, rules, or regulations of all authorities having jurisdiction, and notice of necessary items of work omitted.

9. If the Contractor fails to give such written notice, it shall be assumed that he has included cost of all items in his proposal, and he shall be held responsible for satisfactory functioning and approval of the entire installation without extra compensation.

1.05 MATERIALS AND WORKMANSHIP

A. All material and equipment supplied by the Contractor shall be new and in perfect condition. It shall, where applicable, bear the Underwriters' Laboratories, Inc. label.

B. Material and equipment shall be the standard product of a manufacturer regularly engaged in the production of such products, and shall be the latest design that complies with these Specifications.

C. The equipment furnished under these Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer.

D. The specification of equipment and material of a particular manufacturer is not intended to preclude the use of equal equipment and material of other manufacturers; however, substitutions may be made only with written approval.

E. The Contractor shall submit a list of material and equipment which he intends to supply. The list shall be submitted within 30 days after notice to proceed with the installation, and before purchase of the equipment and material. The list shall include:

1. Catalog Data: Manufacturer's literature and illustrations.

2. Manufacturer's specifications and engineering data showing its compliance with specifications, associated standards, and test requirements.

3. Shop Drawings.

4. Equipment Supplier's Certification (when required).

5. Prior to obtaining any material detailed Shop Drawings on all material shall be submitted.

6. Samples of any material shall be submitted upon Engineer's request.

7. Corrections or comments made on Shop Drawings during the review do not relieve the Contractor from compliance with requirements of the Contract Documents, Plans and Specifications. Shop Drawings will be checked for general conformance with the design concept of the project and general compliance with information given in the Contract Documents. Review of Shop Drawings shall not relieve the Contractor from responsibility for confirming and correlating all quantities and dimensions, coordinating his work with that of other trades, and performing his work in safe and

satisfactory manner. Review of Shop Drawings shall not permit any deviation from Drawings and Specifications.

8. Product Coordination:

   a. Where Contract Documents permit selection from several product options, do not proceed with purchasing until coordination of interface requirements has been checked and satisfactorily established.

   b. Electrical service required for all equipment furnished under other divisions of these Specifications shall be furnished and connected as part of this work. It is part of the work of this division to obtain correct roughing-in dimensions and requirements for the equipment.

F. Protected Work:

1. General:

   a. Plywood backing panels for interior electrical equipment shall be 3/4 inch flame retardant treated, standard grade interior type plywood with exterior glue. Exterior plywood panels shall be 3/4 inch painted marine plywood.

2. Hazardous Areas:

   a. In the areas designated as Hazardous and where explosion-proof work is shown or specified, all equipment and work shall meet the requirements of the NEC for Class 1, Division 1, Group D locations.

3. Wet Locations:

   a. Where installed outdoors or in areas designated as wet locations, all work shall meet the requirements of the NEC for wet locations.

4. Concealed work shall be left open for inspection and test until approval by the Engineer.

G. Delivery, Handling and Storage of Material:

1. It is recognized that space at a project for storage of materials and products is limited. Coordinate deliveries of electrical materials and products with scheduling and sequencing of work so that storage requirements at the site are minimized.

2. Materials and equipment shall be delivered to the site of the work in their original containers, and containers shall not be opened until inspected by the Engineer.

3. Electrical equipment shall, at all times during construction, be adequately protected against mechanical injury or damaged by water.

    a. If any apparatus has been damaged, such damage shall be made good by the Contractor at his own expense.

    b. Equipment shall be stored in accordance with manufacturer's recommendations. Temporary heaters shall be provided as required to prevent condensation.

H. Equipment Finishes:

1. All finishes shall be in good condition at the completion of the job. If finishes are damaged, restore paint on all cabinets and enclosures by complete repainting if necessary.

I. Completion of Work:

1. All materials and manner of installation shall be strictly in accordance with the requirements of the Ordinances of the Local and State Board, the Code of the National Board of Fire Underwriters, and the Local Power Utility, and must pass all inspections, and also will be subject to the approval of the Engineer.

    a. When any public authority, by-laws, or ordinances requires any work to be tested or approved, the Contractor shall provide proper facilities for such test and inspection and all costs of same shall be borne by the Contractor.

    b. On completion of his work, the Contractor shall remove all temporary equipment and wiring. All temporary fuses and lamps for construction use shall be replaced with proper size fuses and lamps.

    c. The Contractor shall retain in his possession and shall be responsible for all portable and detachable portions of the installation such as fuses, keys, locks, etc. until completion of the work, and he then shall deliver them to the Engineer, and obtain an itemized receipt. This receipt, together with the Certificate of Approval, shall be delivered to the Engineer prior to, or at the time of, the Engineer's final inspection of the work.

J. Continuity of Services:

1. When existing buildings are in use during construction operations, keep all existing electrical systems in operation within all rooms of building at all times.

2. Schedules for various phases of contract work shall be coordinated with all other trades and with the Engineer.

3. When connecting new facilities, do not shut off any existing mechanical/electrical facilities or services without prior written approval of the Engineer.

4. The Contractor shall be expected to provide temporary power and light, at the direction of the Engineer.

K. Removal of Excess Material and Refuse:

1. When work is in process, the Contractor shall keep the jobsite in a neat and orderly manner - daily housekeeping, disposal of refuse, and not allow excess material or refuse to collect and impede work flow. At the direction of the Engineer, he shall remove such excess. At the end of the job, the Contractor shall remove all equipment and material that are not part of the final installation.

1.06 ELECTRICAL WORK CLOSEOUT

A. During electrical closeout phase, meet with Engineer frequently and agree upon status of operational responsibility for electrical systems, including security provisions to prevent unauthorized operation, including protective measures to ensure that systems are not neglected or misused.

B. Except where otherwise indicated, electrical Drawings are diagrammatic in nature and may not show locations accurately for various components of electrical systems. Shop Drawings prepared by the Contractor show certain portions more accurately to scale and location, and in greater detail. It is recognized that actual layout of installed work may vary substantially from both Drawings and Shop Drawings.

C. Coordinate test runs of electrical systems with test runs of equipment served thereby. Check each item in each system to determine that it is set for proper operation. With the Engineer present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of systems to refine and improve performance where possible, including noise and vibration reduction, elimination of hazard, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be reasonably requested for the Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible.

D. After final performance test run of each electrical system, clean system both internally and externally. Touch-up minor damage to painted finishes, refinish work where damage is extensive.

PART 2 - PRODUCTS

A. Not applicable.

PART 3 - EXECUTION

A. Not applicable.

END OF SECTION

DIVISION 16 - ELECTRICAL

SECTION 16020 - INSTALLATION TESTING SPECIFICATION

1. ELECTRICAL TESTING

1.1 ELECTRICAL TESTING - GENERAL

1.1.1 Electrical equipment and installations shall conform to the electrical acceptance tests covered under these specifications.

1.1.2 NETA procedures or test values referenced herein are contained in the "Acceptance Testing Specification for Electrical Power Distribution Equipment & Systems" as published by the International Electrical Testing Association, Inc. NETA STD ATS-1991.

1.1.3 The contractor shall be responsible and liable for correcting any problems found, by inspection or testing, which were caused by poor installation techniques, methods or workmanship.

1.1.4 Determination of the cause of the problem shall be the responsibility of the Owner's representative.

1.1.5 Liability shall include replacement or repair of Owner or contractor furnished equipment or material to Owners satisfaction and shall not cause a delay in contract completion date.

1.1.6 The contractor may, at his discretion, request copies of the test data concerning the problem area.

1.1.7 The testing of electrical equipment and installations above 600 volts will be performed by the Owner. Testing that is not to be performed by the contractor shall be coordinated by the Owner's representative.

1.1.8 Testing equipment shall be furnished by the contractor. Testing equipment and testing personnel qualifications shall be subject to approval by the Owner's representative.

1.1.9 Testing equipment, except that required for high potential tests and ground tests, shall be furnished by the contractor. The Owner will furnish equipment for high potential and ground tests. Testing equipment and testing personnel shall be subject to approval by the Owner's representative.

1.1.10 Testing equipment will be furnished by the Owner.

1.1.11 Notify the Owner's representative before performing any test, and at least 24 hours prior to performing high potential tests or final equipment operational tests.

1.1.12 Reasonable cooperation shall be extended to equipment manufacturer's representative to permit the witnessing of their material or equipment under test when requested and approved by the Owner's representative. Tests are to be performed by the contractor and witnessed by the Owner's representative.

1.1.13 Notify the Owner's representative of the failure of any material, equipment or system to pass a test not later than the same day the test is performed.

1.2 ELECTRICAL TESTING - GROUNDING

1.2.1 Underground connections will require visual inspection and approval by the Owner's representative before backfilling.

1.2.2 Ground rods shall be tested utilizing a ground test megger.

1.2.3 Notify Owner's representative if the resistance of each ground rod to earth exceeds 5.0 ohms. (note. requirements are; NEC - 25 ohms, Good practice for industrial plants - 5.0 ohms, Power stations and relaying - 1.0 ohm.)

1.2.4 Pigtails shall show a resistance of 0.5 ohm or less to the system ground grid using a ground test megger.

1.2.5 Grounded equipment shall show a resistance of 0.5 ohm or less to the system ground grid or ground bus.

1.2.6 System grounds, including pole line grounds, shall be tested by the contractor with a ground test megger. Grounds shall be individually identified with brass tags and resistance measurements recorded.

1.3 ELECTRICAL TESTING - CABLES

1.3.1 Visual and Mechanical Inspection:

1.3.1.1 Cables shall be inspected for physical damage and proper connection in accordance with single line diagram and applicable schematic.

1.3.1.2 Cable connections shall be torque tested per NETA Table 11.1.

1.3.1.3 Inspect for shield grounding (shielded cables only), cable support and termination.

1.3.1.4 Visible cable bends shall be checked against ICEA or manufacturer's minimum allowable bending radius.

1.3.2 Electrical Tests - 600-Volt Power, Control and Lighting Conductors:

1.3.2.1 Lighting branch circuits shall be tested during construction to see that the circuits perform functions for which they are designed.

1.3.2.2 Control circuits shall be tested during construction to assure the circuits perform the functions for which they are designed.

1.3.2.3 Each power conductor shall be tested using 1000 volt megger for one minute between conductor and ground with other conductors in the same raceway grounded. Minimum insulation resistance values shall not be less than two megohms.

1.3.2.4 When insulation resistance must be determined with all switchboards, panelboards, fuse holders, switches and overcurrent devices in place, the insulation resistance when tested at 500 volts D.C. shall be no less than one megohm.

1.3.3 Electrical Tests - Instrument and Electronic Cable

1.3.3.1 Individual wires shall be disconnected before testing.

1.3.3.2 Continuity and identification of all single and multi-conductor cables and thermocouple wires shall be checked by means of a D.C. test device using a bell or buzzer to "ring out" the wires.

1.3.3.3 Polarity, point-to-point continuity and identification checks of instrument and electronic cables and shield drains shall be made.

1.3.3.4 Phones may be used for communication only between the testers.

1.3.3.5 Using bell of buzzer determine if conductors are isolated from shield while wires are disconnected.

1.4 ELECTRICAL TESTING - MOTOR CONTROLLERS and SWITCHGEAR

1.4.1 Visual and Mechanical Inspections

1.4.1.1 A visual check shall be made for loose, missing or broken parts and inadequate clearances.

1.4.1.2 Inspect for proper anchorage, grounding and level in accordance with design drawings or manufacturer's recommendation.

1.4.1.3 Manually operate starters, breakers, relays, etc., to determine satisfactory operating condition and that electrical clearances are adequate for service.

1.4.1.4 Draw-out starters, contactors and breaker units shall be racked completely in and out three times to check of freedom of operation.

1.4.1.5 Inspect arc chutes for any visual damage.

1.4.1.6 Compare overload heaters with motor full load current for proper size to trip at 110 percent of motor full load current or the nearest standard size overload to this value.

1.4.1.7 Check breaker overcurrent trip elements for proper setting.

1.4.1.8 Check tightness of bolted connections in accordance with NETA Table 11.1.

1.4.1.9 Wear indicators on vacuum contactors should be checked for proper setting. Indicators for all three phases of a contactor should be set equal prior to placing equipment in service.

1.4.2 Electrical Tests - 600 Volt Class Controllers and Switchgear

1.4.2.1 Measure insulation resistance of each bus section phase to phase and phase to ground for one minute with breakers or switches open and no external power cables connected.

1.4.2.2 Repeat above test except with all breakers or switches closed.

1.4.2.3 Measure insulation resistance of each starter unit in motor control center phase to phase and phase to ground with the starter contacts closed and the protective device open.

1.4.2.4 Measure insulation resistance of each control circuit.

1.4.2.5 Insulation resistance test voltage and minimum acceptable values shall be in accordance with NETA Table 11.2.

1.4.2.6 Bus connections on main horizontal bus shall be given a ductor resistance test. Minimum acceptable reading shall be 100 micro-ohms.

1.4.2.7 Molded case circuit breakers used as the incoming main for motor control centers shall be given a Ductor resistance test across each pole. Minimum acceptable value shall be 100 micro-ohms and deviations between adjacent poles shall be no more than 50 percent.

1.4.2.8 Air circuit breakers shall be given a Ductor resistance test. Any values exceeding 100 micro-ohms or any values which deviate from adjacent poles or similar breakers by more than 50 percent shall be investigated.

1.4.2.9 Air circuit breakers shall be given an insulation resistance test at 1000 volts D.C. for one minute from pole to pole and from pole to ground and across open contacts of each phase. Minimum acceptable value is 50 megohms.

1.4.2.10 Perform operational test of control and interlocks with control circuits properly energized but with no load cables connected.

1.4.2.11 Operate circuit breakers from each control point. Trip by manually making every control relay. Check control circuits, automatic operations, and interlocks for correct operation. Indication lights, annunciators, alarms, and targets shall be observed to verify correct operation.

1.4.3 Pneumatic System Test

1.4.3.1 Inspect air and associated electrical connections for workmanship and conformance with the drawings.

1.4.3.2 Compressor motors shall be tested as outlined in the motor testing section.

1.4.3.3 Before startup, the system including breaker reservoirs shall be fully charged. Automatic pressure controls for cut-off and cut-on shall be checked.

1.4.3.4 Set unit pressure switches on each circuit breaker in accordance with instructions

1.4.3.5 Pressure switches shall be checked for correct operation. automatic sequential operation of the compressors associated with each switchgear group shall be checked.

1.4.3.6 The system shall be tested over a period of 15 to 20 hours to determine a measure of the leakage of the system with no breaker operation. If leakage exceeds manufacturer's allowable, see Owner's representative for leak test instructions.

1.5 ELECTRICAL TESTING - CONTROL BOARDS

1.5.1 Panel wiring shall be confirmed by operational checks on all control circuits.

1.5.2 Indicating instruments (except recorders), meters, and relays shall be removed from their panels and given to the Owner's representative for calibration. After calibration they shall be replaced in their respective panels.

1.5.3 Visually check grounding of control boards.

1.6 ELECTRICAL TESTING - MOTORS

1.6.1 Check motors when received for damage. Megger and record readings. If below acceptable minimum reading immediately notify Owner's representative.

1.6.2 Motors shall be rotated a minimum of once a month during storage and after installation. Check sleeve bearing oil reservoir prior to rotating.

1.6.3 Motors shall be tested again for minimum megger readings prior to installation.

1.6.4 Motors, 575 volts and below, shall be tested with a 500 volt megger. Minimum acceptable reading shall be 3 megohms for 115 volt motors and 5 megohms for motors rated above 115 volts.

1.6.5 Motors rated 2300 volts and above shall be tested with a 2500 volt megger. Minimum acceptable reading shall be 20 megohms.

1.6.6 Motors rated 4000 volts shall be given a D.C. high potential test of 7.5 kV. Test shall be for one minute duration.

1.6.7 Motors rated nominal 13.8 kV shall be given a D.C. high potential test of 23.0 kV. Test shall be for one minute duration.

1.6.8 Motors 500 hp and larger rated at 2300 volts or 4000 volts shall be given a dielectric absorption test with a 2500 volt megger. Polarization test shall be performed on motor winding for a ten minute duration. Sixty/thirty second ratio test shall be for one minute duration. Polarization index readings should be greater than 1.5 and sixty/thirty second ratio greater than 1.0.

1.6.9 Motors rated nominal 13.8 kV shall be given a dielectric absorption test with a 5000 volt megger. Polarization test shall be performed on motor winding for a ten minute duration. Sixty/thirty second ratio tests shall be for one minute duration. Polarization index reading should be greater than 1.5 and sixty/thirty second ratio should be greater than 1.0.

1.6.10 Test for rotation and electrical center shall be made with each machine uncoupled. Motor shall also be checked for excessive vibration. Vibration amplitudes shall not exceed values shown in NETA Table 8.15.1.

1.6.11 Cables and motors shall be tested with cables connected to the motors immediately prior to energization. Use 500 volt megger for 575 volt and below, use 2500 volt megger for 2300 volt and above. Minimum acceptable reading for 115 v motors shall be 3 megohms, 460 volt and 575 volt motors - 5 megohms, and 2300 volt motors and above - 15 megohms.

1.6.12 Final acceptance of rotating equipment cannot be made until the equipment is energized during operational tests.

1.6.2 Electrical Tests:

1.6.2.1 Before applying megger and high potential tests the bus shall be disconnected from its associated equipment and the metal enclosure grounded.

1.6.2.2 Measure insulation resistance of each bus run phase to phase and phase to ground for one minute. Test voltage shall be in accordance with NETA Table

11.2. Insulation resistance values should not be less than manufacturer's minimum values.

1.7 ELECTRICAL TESTING - HEAT TRACING

1.7.1 Test each lead of each assembly or each cable section between lead and sheath prior to installation using a 500 volt megger.

1.7.2 Repeat megger test for each assembly after initial placement is completed but prior to placing permanent hold down tape or channel-strapping.

1.7.3 Repeat megger test for each assembly after completion of installation but prior to placement of insulation.

1.7.4 Minimum megger reading shall be 10 megohms.

1.7.5 Test each circuit for continuity prior to energizing.

1.7.6 After energizing check voltage and current for each assembly. Compare with design calculations, and report significant variations to the Owner's representative.

1.8 ELECTRICAL TESTING RESULTS

1.8.1 Tests made on electrical equipment shall shall show the following:

Test Equipment Utilized

Date Of Test

Identity Of Equipment

Paragraph Numbers Of This Specification Used As A Basis For The Test.

Test Results

Any Corrective Action Taken To Make Equipment Pass Test

Statement As To What Is Required For Equipment Before It Is Energized Or Placed In Service

Note That Entry Of Test Result Was Made On "White" Equipment Tag In Accordance With Owner's Safety Manual

Name Of Person Or Persons Making Test

1.8.2 Tests made on electrical equipment shall be entered on the electrical acceptance testing forms provided by Owner.

1.8.3 Three (3) copies of all test data and test procedures shall be furnished to the Owner's representative for distribution as follows:

1 copy - for Owner's representative (Radian)
1 copy - for Project Manager
1 copy - for Project Electrical Engineer

1.8.4 Three (3) copies of test data and test procedures shall be furnished to the Owner's representative.

1.9 Questions concerning procedures, methods or alternate tests shall be referred to Owner's representative for clarification or approval.

1.10 Drawings - One (1) copy of electrical drawings shall be marked per field changes and furnished to the Owner's representative.

1.11 Drawings - -Two (2) new copies of electrical drawing shall be marked per field changes and furnished to Owner' representative.

DIVISION 16 - ELECTRICAL

SECTION 16500 - LIGHTING FIXTURES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Luminaries and accessories.

B. Lamps.

C. Ballasts.

D. Emergency lighting units.

E. Unless specifically stated otherwise, the Contractor shall satisfy all of the special conditions described in this section and shall provide all necessary labor, materials, equipment, tools, utilities and protective equipment as required by these contract documents to provide a complete and finished job, acceptable to the permitting authorities, the NSL Trust Representative(s) and in compliance with the latest edition of applicable local, state and federal codes.

1.02 REFERENCES

A. ANSI C82.4 - Specifications for HID Lamp Ballasts.

B. NEMA LE 2 - H-I-D Lighting System Noise Criterion (LS-NC) Ratings.

C. NEPA 101 - Code for Safety to Life from Fire in Buildings and Structures.

2.01 LUMINARIES AND ACCESSORIES

A. HID Luminaries - Pre-wired with integral ballast.

B. Enclosures - In complete compliance with NEC for installation in Class I, Division I (classified) location.

2.02 ACCEPTABLE MANUFACTURERS

A. Appleton.

B. Killark.

2.03 LAMPS

A. High Pressure Sodium HID Lamps - coated, suitable for all burning positions.

2.04 ACCEPTABLE MANUFACTURERS - LAMPS

A. Advance.

B. General Electric.

C. Jefferson.

2.05 HID BALLASTS

A. HID Ballast, ANSI C82.4 - selected by luminaire manufacturer.

B. LS-NC Rating, NEMA LE 2 - equal to or less than ratings listed in Table C-1.

2.06 EMERGENCY LIGHTING UNITS

A. Emergency lighting unit - self contained unit with rechargeable storage batteries, charger and lamps.

B. Battery - 7 volt, lead calcium type with 1.5 hour capacity to supply the connected lamp load.

C. Charge - Dual-rate charger capable of maintaining the battery in a full-charge state during normal conditions and capable of recharging discharged battery to full charge within 12 hours.

D. Lamps - 12 watt minimum, tungsten halogen type.

E. Unit Housing - NEMA 4x or NEMA 7 as required.

F. Indicators - Provide lamps to indicate AC on and recharging.

3.01 INSTALLATION

A. Support surface-mounted luminaries directly from building structure in compliance with NEC requirements for Class I, Division I (classified) location.

B. Install recessed luminaries to permit removal from below.

3.02 RELAMPING

A. Relamp luminaries which have failed lamps at completion of work.

3.03 ADJUSTING AND CLEANING

A. Align luminaries and clean lenses and diffusers at completion of work. Clean paint splatters, dirt and debris from installed luminaries.

B. Touch up luminaire finish at completion at work.

3.04 LUMINARE SCHEDULE

A. See construction drawings.

END OF SECTION